Including ELECTRONIC INDUSTRIES for

See Pa

TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

IN TWO PARTS • PART ONE

RB-29 radar operator of 31st Strategic Reconnaissance plotting photographic flight line over North Korea

New Vacuum Tube Materials • Design Trends in Military Airborne Communications • Tunable X-band Magnetron

June • 1951 CALDWELL-CLEMENTS, INC

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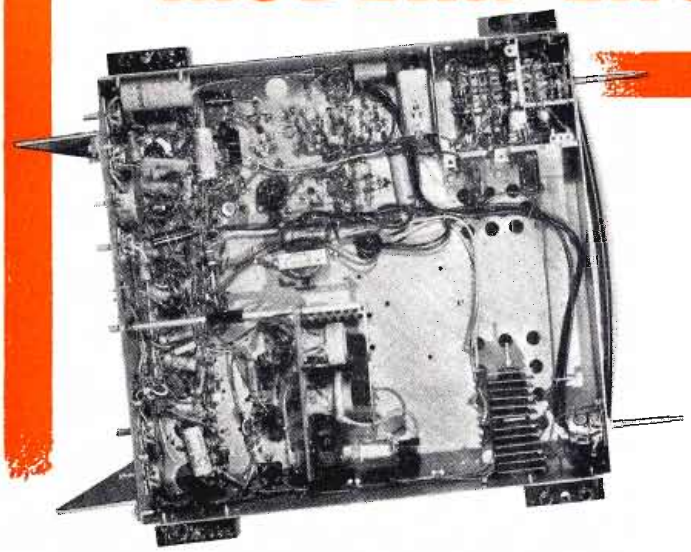
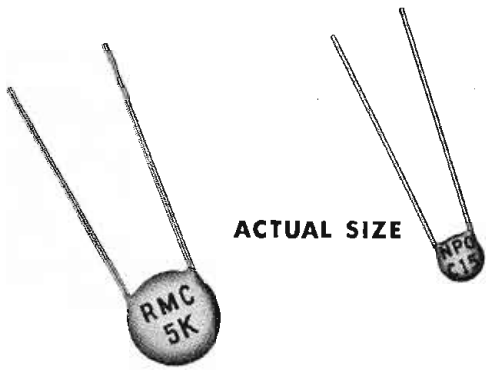
Please Route to

A Good Example of
MODERN ENGINEERING*



RMC DISCAPS
Used in this New Motorola Chassis

BY-PASS TYPES	TEMPERATURE COMPENSATING TYPES
7 — .005 MFD	1 — 150 MMF ± 20% N-750
7 — .001 MFD	2 — 30 MMF ± 10% N-150
4 — .0015 MFD	1 — 68 MMF ± 10% N-470
2 — 2 × .008 MFD	1 — 180 MMF ± 20% 3000 volt



ACTUAL SIZE

MOTOROLA'S
NEW TS-196
TELEVISION CHASSIS

A total of 27 RMC By-pass and Temperature Compensating "DISCAPS" are incorporated in this new Motorola TV chassis. Motorola engineers specified them in place of tubular ceramic and mica condensers because of their outstanding performance and cost savings as well as their availability in these trying times.

Engineering costs out of a TV or radio chassis without sacrificing quality or performance is a mighty important job today. You, too, will find an important cost savings by specifying RMC By-pass and Temperature Compensating "DISCAPS."

If you will advise us of the types of tubular ceramic and mica condensers which you are now using, we will send samples of RMC "DISCAPS" with prices. The savings will be very apparent.

RMC "DISCAPS"
THE RIGHT WAY TO SAY
CERAMIC CAPACITORS

***Engineering with an Eye to Quality and Cost Savings**

DISCAP CERAMIC CONDENSERS

RMC

RADIO MATERIALS CORPORATION
GENERAL OFFICE: 1708 Belmont Ave., Chicago 13, Ill.
FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.
Two RMC Plants Devoted Exclusively to Ceramic Condensers

JUNE, 1951 IN TWO PARTS • PART TWO

TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

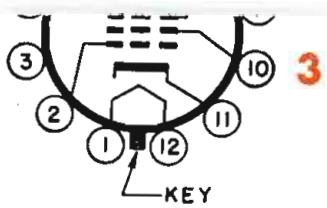
Number of TV Receivers in Use, by Market Areas

The following figures are based on the population residing within the 0.1-millivolt contour, which is considered to fall approximately 60 miles from station. Computations based on national totals projected to June 1, 1951

City	Families	Sets Installed	% Saturation	Number of Stations
Ames	195,200	49,000	25%	1
Atlanta	311,000	99,000	32%	2
Baltimore	461,000	292,000	63%	3
Birmingham	252,400	47,500	19%	2
Bloomington	49,300	15,400	32%	1
Boston	1,084,000	720,000	66%	2
Buffalo	309,400	195,000	63%	1
Charlotte	330,800	63,000	19%	1
Chicago	1,668,400	910,000	55%	4
Cincinnati	432,600	249,000	58%	3
Cleveland	804,800	465,000	58%	3
Columbus	327,300	141,000	43%	3
Davenport	205,100	51,000	25%	2
Dayton	275,500	123,000	45%	2
Detroit	907,200	450,000	50%	3
Erie	84,800	45,500	54%	1
Grand Rapids	194,500	79,000	41%	1
Greenboro	162,100	59,000	36%	1
Huntington	187,500	39,000	21%	1
Indianapolis	390,200	120,000	31%	1
Jacksonville	113,800	28,700	26%	1
Johnstown	310,100	77,000	35%	1
Kalamazoo	153,700	36,000	23%	1
Kansas City	471,900	111,000	24%	1
Lancaster	215,900	86,500	40%	1
Lansing	206,900	47,200	23%	1
Louisville	256,400	85,000	33%	2
Memphis	269,900	81,000	30%	1
Milwaukee	373,600	232,000	62%	1
Minneapolis	452,900	257,000	57%	2
Nashville	205,700	25,500	12%	1
New Haven	515,400	149,000	29%	1
New York	3,887,000	2,300,000	59%	7
Norfolk	204,200	61,500	30%	1
Omaha	217,600	68,000	31%	2
Philadelphia	1,343,900	835,000	62%	3
Pittsburgh	729,200	247,000	34%	1
Providence	406,100	141,000	34%	1
Richmond	133,700	70,500	53%	1
Rochester	216,700	795,000	37%	1
Schenectady	322,500	151,000	47%	1
St. Louis	567,700	275,000	48%	1
Syracuse	205,200	111,000	54%	2
Toledo	300,100	89,000	30%	1
Utica	124,100	39,500	32%	1
Washington	450,600	249,000	55%	4
Wilmington	135,400	61,000	45%	1

NON-INTERCONNECTED CITIES

City	Families	Sets Installed	% Saturation	Number of Stations
Albuquerque	133,100	8,100	6%	1
Binghamton	84,100	35,300	42%	1
Dallas, Ft. Worth	369,800	111,000	31%	3
Houston	307,500	71,000	23%	1
Los Angeles	1,537,800	890,000	58%	7
Miami	154,600	56,500	37%	1
New Orleans	257,700	53,500	21%	1
Oklahoma City	239,000	81,500	34%	1
Phoenix	89,600	38,500	43%	1
Salt Lake City	83,700	39,500	47%	2
San Antonio	157,000	42,500	27%	2
San Diego	182,100	89,000	49%	1
San Francisco	974,300	171,000	18%	3
Seattle	425,400	77,000	18%	1
Tulsa	152,500	67,000	44%	1
Total Stations	107	Total TV Sets		12,752,700
Total Families	26,571,500	Average Saturation		48%

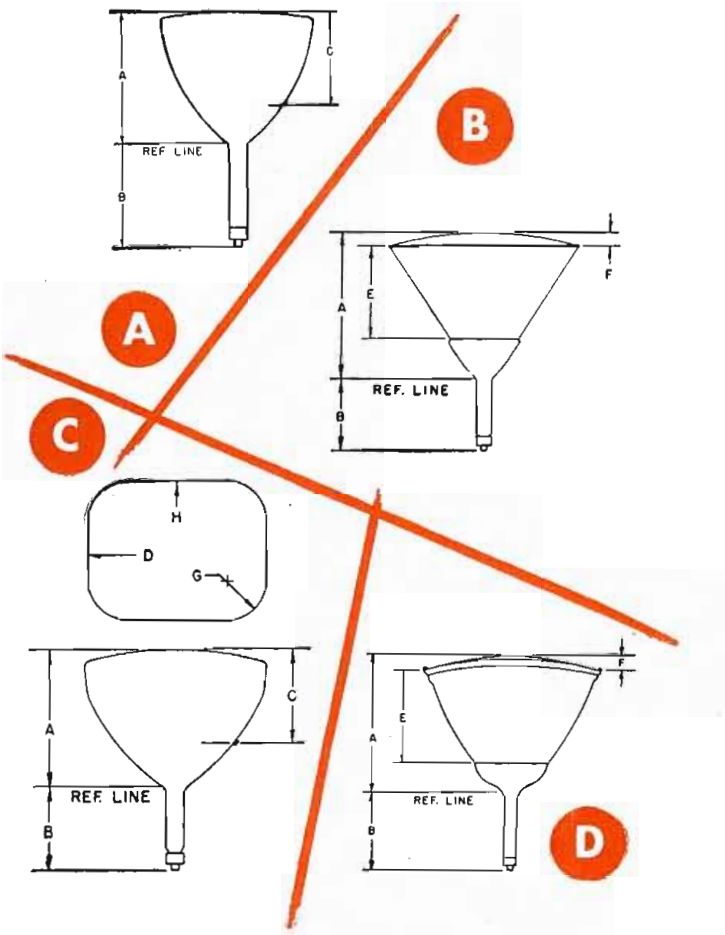


12L

BULB

IMPORTANT
line informa

Bulb Outlines



Basic Type	See Outline	A	B	C	D	E
10BP4	A	9 7/16	8 3/16	7 1/8		
10CP4	A	9 7/16	7 3/16	7 1/8		
10EP4	A	9 7/16	8 3/16	7 1/8		
10FP4	A	9 7/16	8 3/16	7 1/8		
10MP4	A	9 7/16	7 9/16	7 1/8		
12JP4	A	10 1/2	7	7 3/8		
12KP4	A	10 1/2	7 1/2	7 1/2		
12LP4	A	10 1/2	8 1/4	7 1/2		
12QP4	A	10 1/2	7	7 1/2		
12RP4	A	10 1/2	7	7 3/8		
12TP4	A	10 1/2	8 1/4	7 1/2		
12UP4	B	10 5/8	8			7 1/2
12VP4	A	10 1/2	7 1/2	7 1/2		
14BP4	C	9 9/32	7 17/32	6 21/32	∞	
14CP4	C	9 9/32	7 15/32	6 5/8	∞	
14DP4	C	9 9/32	7 15/32	6 21/32	∞	
14EP4	C	9 9/32	7 3/16	6 21/32	∞	
14FP4	C	9 9/32	6 7/8	6 5/8	∞	
15AP4	A	13 9/16	6 15/16	6 9/16		
15CP4	A	13 1/2	8	6 1/4		
15DP4	A	13 9/16	6 15/16	6 1/4		
16AP4	B	14 11/16	7 9/16			11
16CP4	A	14 7/8	6 5/8	10 7/8		
16DP4	A	12 7/8	8 3/16	7 1/2		
16EP4	B	12 3/4	6 7/8			9 11/16
16FP4	A	13 1/4	7	9 1/4		
16GP4	B	10 3/8	6 7/8			7 5/16
16HP4	A	12 1/8	8 3/8	7 1/2		
16JP4	A	13 1/4	7 1/8	9 1/4		
16KP4	C	11 1/4	7 1/2	6 7/16	∞	
16LP4	A	14 7/8	7 3/8	7 1/2		

DUMONT

Fir

IMPORTANT

To obtain a comparison among the tube types listed, focus current is specified for the following standard comparative conditions, which do not necessarily imply typical operating conditions.

COMPARATIVE OPERATING CONDITIONS

Focus Current or Focusing Electrode Voltage	Anode Volts	Neg. Grid #1 Cut Off Volts	Grid #2 Volts
(see listings)	12,000	33-77	300

ALL TYPES listed employ a white fluorescent screen of medium persistence.

HEATER VALUES are 6.3 volts, 0.6 amps.

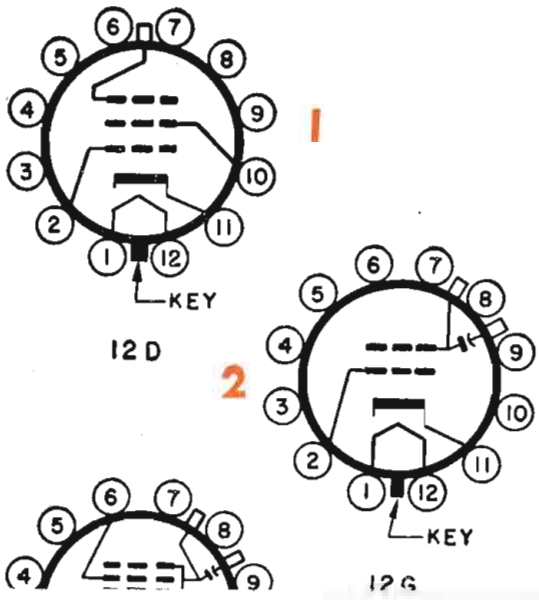
Code and Specification Notes

EXT = external conductive coating
RT–G = rect. with gray face
RD–C = round with clear face
RD–G = round with gray face
FF = frosted (or etched) face
MB = metal-backed screen
CQ = see Type 12QP4A for suggested replacement
Q = suggested replacement for Types 12JP4 and 12RP4
CD = for replacement see Type 15DP4
* = Types employ RTMA Focus Coil #109 (approx. 470 ohms); all others RTMA Focus Coil #106 (approx. 264 ohms).

Data is based on latest information available from the RTMA Data Bureau.

◀ = Du Mont Teletrons

Basings



	16GP4A 16GP4B 16GP4C	RD-C RD-G-FF RD-C-FF	12D	17 11/16
	16HP4 16HP4A	RD-C-EXT RD-G-EXT	12D	21 1/4
	16JP4 16JP4A	RD-C-EXT RD-G-EXT	12D	20 3/4
	16KP4 16KP4A	RT-G-EXT RT-G-EXT-MB	12D	18 3/4
	16LP4 16LP4A	RD-C-EXT RD-G-EXT	12D	22 1/4
	16MP4 16MP4A	RD-C-EXT RD-G-EXT	12D	21 3/4
	16QP4	RT-G	12D	19 9/64
	16RP4	RT-G-EXT	12D	18 3/4
	16SP4 16SP4A	RD-C-EXT RD-G-EXT	12D	17 5/16
◀	16TP4	RT-G-EXT	12D	18 1/8
	16UP4	RT-G	12D	18 1/8
	16VP4	RD-G	12D	17 3/16
	16WP4 16WP4A	RD-G RD-G-EXT	12D	17 3/4
	16XP4	RT-G	12D	18 3/4
	16YP4	RD-G-EXT	12D	17 5/16
	16ZP4	RD-G-EXT	12D	22 1/4
◀	17AP4	RT-G	12D	18 5/8
◀	17BP4 17BP4A 17BP4B	RT-G RT-G-EXT RT-G-EXT-MB	12D	19 1/4
	17CP4	RT-G	12D	18 1/2
◀ ◀	19AP4 19AP4A 19AP4B 19AP4C 19AP4D	RD-C RD-G RD-G-FF RD-G-MB RD-C-FF	12D	21 1/2
	19DP4 19DP4A	RD-C-EXT RD-G-EXT	12D	21 1/2
	19EP4	RT-G-EXT	12D	21 1/8
	19FP4	RD-C-FF	12D	22
	19GP4	RD-G	12D	21 1/4
	19JP4	RT-G	12D	20 13/16
◀	20BP4	RD-C	12D	28
◀ ◀	20CP4 20CP4A	RT-G RT-G-EXT	12D	21 7/16
	20DP4A	RT-G-EXT	12D	21 3/4
	22AP4 22AP4A	RD-C RD-G	12D	22 7/8
	24AP4 24AP4A	RD-G RD-G-MB	12D	23 5/8
◀	30BP4	RD-G	12D	23 9/16

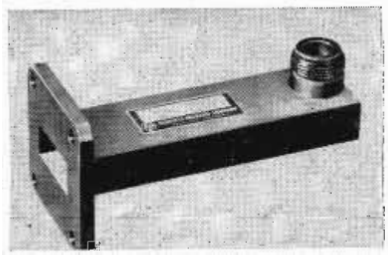
ELECT

	Type	Code	Basing	Overall Length
◀	17FP4	RT-G-EXT	12L	19 1/4
	17GP4	RT-G-FF	12L	19 5/16
◀	20FP4	RT-G	12L	21 3/4
◀	20GP4	RT-G-EXT	12L	21 3/4

NEW COMMUNICATION PRO

Coaxial Adaptor

The 280A and 281A waveguide-to-coaxial adaptors permit convenient transitions between waveguide and



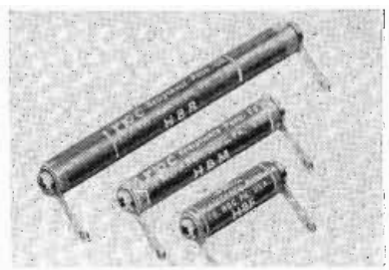
coaxial systems. Each adaptor covers its full waveguide range with a VSWR not exceeding 1.5. Power may be fed in either direction. The 280A consists of a coaxical line of proper length protruding into a waveguide section and located to insure a minimum of reflection. This model is offered in waveguide sizes 3 in. x 1½ in. (2.6 to 3.95 kmc). These adaptors employ a ramp to transform waveguide impedance into cable impedance. Five models are offered in sizes: 3 x 1½ in., 2 x 1 in., 1½ x ¾ in., 1¼ x ⅝ in., 1 x ½ in.—**Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Cal.**—TELE-TECH

Noise-Suppression

Thoroughly rugged noise-suppression filters offering high attenuation and current ratings are housed in hermetically-sealed metal cases smaller than previously available units. Primary application is in r-f noise-suppression work in military or commercial aircraft, and again in vehicular dc applications, or specialty applications such as battery or power line dc filters for shielded room applications or specialized equipment. These units are of advanced pi type construction for high efficiency filtering. Capacitor sections utilize Aerovox metallized-paper dielectric to assure maximum reliability and life, and include "fault-isolation" characteristics for protection against surge voltages above rated values. Filter chokes are of newest design, embodying high impedance of r-f currents and low dc resistance, thereby assuring minimum heating and low voltage drop.—**Aerovox Corp., New Bedford, Mass.**—TELE-TECH

Resistors

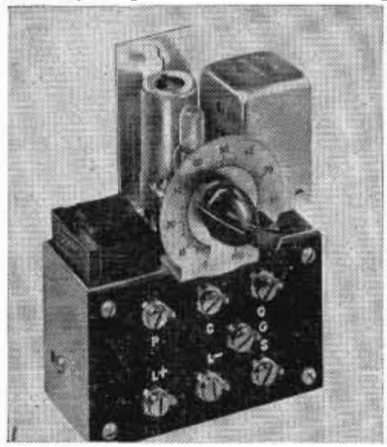
RPC Type H high megohm resistors are stable rugged units which can be furnished with resistance values as



high as 50 million megohms. They are easily mounted on a panel or standoff insulator or can be wired directly into the circuit. Jacketed in polyethylene to provide maximum protection against mechanical damage and humidity, they are well suited for electrometer circuits, radiation equipment, photo cell circuits and as high resistance standards in measuring equipment. — **Resistance Products Co., Harrisburg, Pa.**—TELE-TECH

Relay

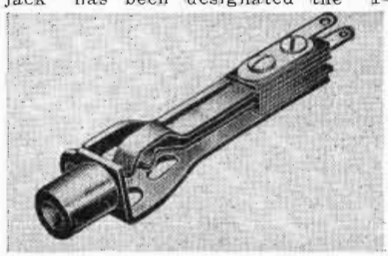
Positive operation on pulses of less than 0.5 millisecond, even with a total resistance as high as 500,000 ohms in the initiating circuit, is provided by the new type CK relay. The control relay operates approximately 10 milliseconds after contact, and normally remains energized for a time, adjustable by means of a delay potentiometer, between 0.25 and 1.5 seconds. Sustained contact at the input causes the control relay to open and close at a rate determined by the contact resistance and the setting of the delay potentiometer. The relay is thus adaptable to use as an on-off timer for life-testing and laboratory applications. By removing an easily accessible neon glow tube from its socket, however, the relay locks in after an initial impulse and remains energized until the power supply is interrupted. A small isolation transformer is incorporated in the unit so that the initiating switch contacts are independent of the power line and one may be grounded if desired. Long



life and ease of maintenance are assured through the use of a low-cost, cold-cathode tube which is inoperative until pulsed, and a rugged plug-in relay provided with a dust-cover. The single-pole double-throw relay contacts are rated at 2 amps, 115 volt ac, non-inductive.—**Farmer Electric Co., 21 Mossfield Road, Waban 68, Mass.**—TELE-TECH

Telephone Type Jack

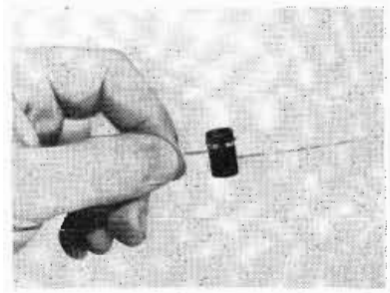
A new long frame type Jack, most commonly referred to as a "telephone jack" has been designated the "T-



JAX." It was designed for high quality communication equipment, and to meet the exacting specifications of the Armed Services. The rugged steel frame, produced in specially-designed dies, is press welded to provide rigidity and dimensional stability. The springs are made of a special alloy of nickel silver insuring maximum spring life and corrosion resistance. Fine silver contacts are standard in switching circuits; palladium cross bar contacts are also available.—**Switchcraft, Inc., 1328 N. Halstead St., Chicago 22, Ill.**—TELE-TECH

Voltage Surge Suppressor

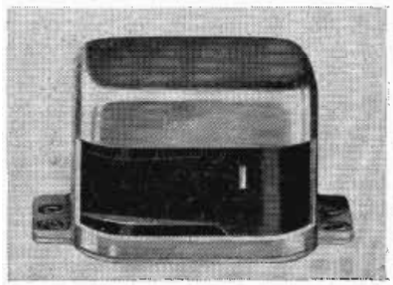
A voltage surge suppressor that will increase by at least 20 times the life of unprotected contacts used in



electromagnetic devices has been developed. The new circuit, which is a result of more than 10 years' work with the selenium rectifier, may be used with relays, contactors, clutch magnets, and solenoids. By limiting the self-induced voltage in these devices, the suppressor increases the life of the contacts that operate them and reduces the electrical stress on the insulation of the coil and wiring. In addition, sparking at the contacts is eliminated or greatly reduced. The characteristics of the recently-developed surge suppressor compare favorably with several commonly-used methods of suppression, including the varistor and the larger and more expensive condenser-resistor combination. Although the selenium suppressor and the varistor show similiar characteristics of protection, the selenium suppressor draws several times less current than some commercial types of suppressors while the circuit is energized. This greater current requirement of the varistor may represent an appreciable power drain, particularly where a large number of relays are involved.—**Federal Telephone and Radio Corporation, Clifton, N. J.**—TELE-TECH

Tape Recording Head

A new Tape Recording Head (TR6) that provides record and playback in one compact unit has been designed

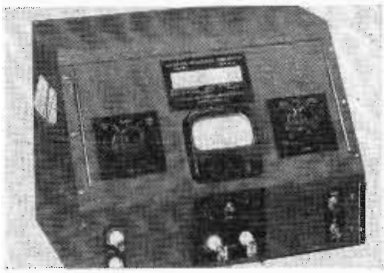


for use in equipment where a separate ac erase or a dc erase may be involved. The TR6 series was developed for mass production at low cost to mechanism manufacturers. It is especially designed for ease in assembly to equipment, as well as for excellent frequency response and output level. The TR6 structure insures production control of gap dimensions and alignment. Another special feature is the fact that it employs an effective deep-drawn, Mu-metal shield for optimum hum reduction. Special technical data: record and playback coil impedance, 1,650 ohms at 1,000 cps; output level, 1 millivolt at 1,000 cps (at tape speed of 3.75 in. per sec.); overall dimensions, 0.685 in. max. height x 1.240 in. width x 1.031 in. depth; bias frequency, 25 KC—**Shure Brothers, Inc., 225 W. Huron St., Chicago 10, Ill.**—TELE-TECH

NEW COMPONENTS and EQUI

Resistance Comparator

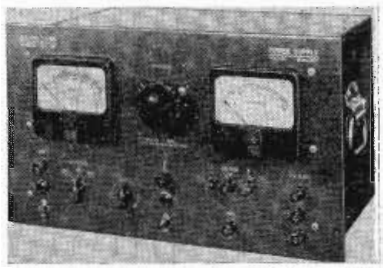
Development of a new high speed Automatic Resistance Comparator has been announced which will enable un-



skilled labor to test as many as 17 resistors per minute, regardless of type. This new instrument, known as type PR-5, is specifically designed and built for checking incoming shipments of resistors, matching, grading to close tolerances, or checking factory output. It is housed in an 18 gauge steel cabinet with grey wrinkle finish and ventilating louvres. The instrument is completely self-contained and requires no outside attachments other than the standard resistor against which the unknown resistors are to be checked. To operate, simply connect fused line plug to any 110 volt ac outlet and turn on. After allowing a few minutes for warm-up, zero is adjusted on meter scale and the standard resistor is connected to the proper terminals. The operator then places resistors to be checked across the "unknown" terminals. To change test from one value resistor to another, merely connect proper standard. No other adjustment is necessary. The meter scale reads in per cent and is calibrated in tbree full scale ranges: —5 to + 5%, —25 to + 30% and —50 to + 100% deviation from standard. — **Clippard Instrument Laboratory, Inc., Bank St., Cincinnati, Ohio**—TELE TECH

Power Supply

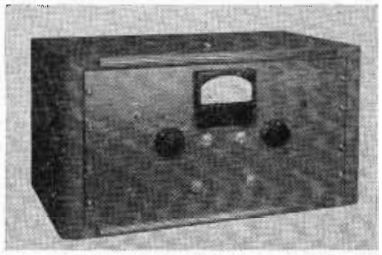
Model 815 power supply features one regulated B supply, one regulated C supply and one unregulated fila-



ment supply. The B supply is continuously variable from 0 to 600 volts and delivers from 0 to 200 ma. In the range 20 to 600 volts the output voltage variation is less than ½% for both line fluctuations from 105 to 125 volts and load variations from minimum to maximum current. Ripple is less than 5 millivolts. The C supply is continuously variable from 0 to 150 volts and delivers 5 ma. For all output voltages the output voltage variation is less than 10 millivolts for line fluctuations of 105 to 125 volts. At 150 volts, the regulation is less than ½% between 0 and 5 milliamperes. At other settings below 150 volts the internal resistance of the supply will increase to a maximum of 25,000 ohms. Ripple is less than 5 millivolts. AC output is 6.3 volts, 10 amperes, center-tapped, unregulated. — **Kepco Laboratories, Inc., 149-14 41st Ave., Flushing, N. Y.**—TELE-TECH

Capacitance Meter

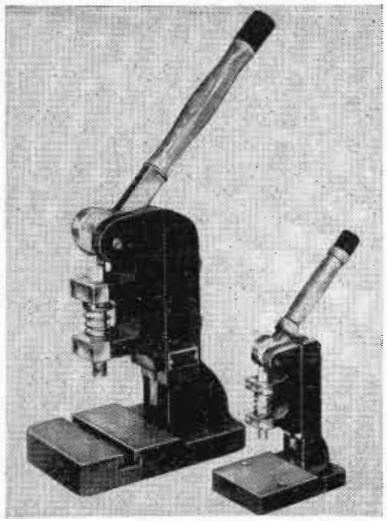
A direct-reading, self-contained, ac operated instrument (model 351) for production measurement of small values of direct capacitance has been developed. Capacitance is read directly on a 4-in. indicating instrument having a logarithmic scale. Full scale ranges are 0.1, 1.0, 10, and 100 uuf. Absolute accuracy is better than 5% and reproductibility is better than ½%. Calibratiou is by means of a built-in standard. A percent-limit indicator can be made part of the instrument. Measurements are made at 500 KC. Power factor is not measured; losses at power factors below 0.05 have negligible effect on capacitance readings. Variations in 60-cps



line voltage, from 95 to 135 volts; do not affect the accuracy of measurement.—**MacLeod and Hanopol, Inc., 10 Joiner St., Charlestown 29, Mass.**—TELE-TECH

Hand Operated Presses

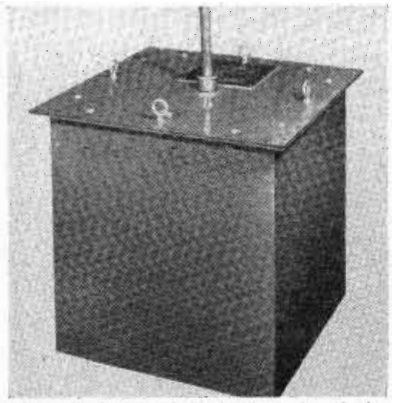
A group of hand and foot operated presses has been developed to speed the assembly of parts needed in elec-



trical devices and radio production plants. Two hand press sizes are available. The larger, weighing 22 lbs., exerting a force of 1,250 lbs., on the part being assembled, has an adjustment of 1½ in. in overall height and a stroke of ⅞ in. permitting a flexible adjustment. All parts are precisiou machined and the weighted hardwood handle adds force to the pressing operation. A coil spring of high tensile strength aids the quick return of the lever. A T-slot in the 5 x 5 in. base allows for easy insertion of tools or fixtures. Featuring the same basic construction as the larger press, but designed for lighter assembly or riveting operations, the junior size weighs only 6½ lbs., has a ½ in. stroke and 1 in. adjustment. Both units can be modified for foot pedal operation.—**I. H. Bradley & Sons, 264 Fifth St., Bridgeport, Conn.**—TELE TECH

Power Supply

Model 217 power supply is rated at 0-100 KV-DC, 1 ma. At 100 KV and 1 ma, the ripple is less than ½%. The



inherent internal resistance is of the order of 8 megohms. Model 217 is a rectified 60-cps power supply, with all of the high voltage components operated in transformer oil. This reduces corona to an absolute minimum, and renders the unit unusually reliable and rugged. Standard equipment provided with the power supply include: automatic output shorting mechanism that shorts the high voltage to ground as soon as the power supply is deenergized; provision for external interlocks; an overload protection circuit and an output kilovoltmeter. The standard model provides fixed high voltage polarity, either positive or negative as desired. Optional features include reversible polarity, a dual range output kilovoltmeter, and/or load current meter, interlocks to ensure application of the high voltage witb the output control turned to zero, and 4-in. neoprene-tired swivel casters for the high voltage tank so that it may be readily moved.—**Beta Electric Corp., 333 East 103 St., New York 29, N.Y.**—TELE-TECH

Blower Motor

This compact motor (FB-1615) has been designed for 60,400 or variable frequency operation, for single or

polyphase power input. Induction or synchronous type are available. Available iu rating from 1/1000th to 1/50th hp for continuous duty, the FB-1615 can he supplied for ambient temperature operation up to 100° C. It is particularly adaptable for fan and blower application in numerous pieces of electrical equipment, as well as a prime mover in timing devices, aero cameras and sine wave alternators. Rotors are precision dynamically balanced and precision shielding ball-bearings are used.—**Atlas Aircraft Productions Corp., 1 E 53rd St., New York 22, N. Y.**—TELE-TECH

DUMONT

Using the Data Chart

Several important factors must be considered by the technician when using this tube data chart as an index to tube interchangeability.

Bulb Outline *(excluding overall length)*

Tube types with identical bulb outlines present no problem of interchangeability with respect to chassis layout, unless the difference in overall length is so great that the two types in question would not be compatible in the same cabinet design.

Focus Current

When a high focus current tube is replaced for a low focus current tube, it may be necessary to increase the focus current range of the receiver, otherwise, a stronger focus coil must be employed.

Ion-trap Magnet

It is important that the proper external magnet is used with the ion-trap of the tube, paricularly when changing from a double to a single magnet. Since these components are relatively inexpensive, it would seem practical to keep them on hand.

Conductive Coating

If a tube without external coating is replaced for a tube with external coating, a 500 to 1500 $\mu\mu$f. capacitor connected between the high-voltage output lead and ground will insure proper set operation.

Bulb Contact

In general there are three types of connectors to the anode of television tubes, the cavity and ball connectors in all glass types, and the clip connector for types with a metal cone envelope. When making tube changes, the appropriate connector must be used.

Deflection Angle

In practice, the same deflection yoke usually may be employed with all tube types having deflection angles of 66° or over will require a wide-angle deflection yoke.

ELECTRO

Type	Code	Basing	Overall Length
10BP4 10BP4A	RD-C RD-G-EXT	12D	17 5/8
10CP4	RD-C-EXT	12D	16 5/8
10EP4	RD-C	12D	17 5/8
10FP4 10FP4A	RD-C-EXT-MB RD-G-EXT-MB	12D	17 5/8
10MP4 10MP4A	RD-C-EXT RD-G-EXT	12G	17
◀ 12JP4	RD-C-CQ	12D	17 1/2
12KP4 12KP4A	RD-C-EXT-MB RD-G-EXT	12D	17 5/8
12LP4 ◀ 12LP4A	RD-C-EXT RD-G-EXT	12D	18 3/4
◀ 12QP4 ◀ 12QP4A	RD-C RD-G-Q	12D	17 1/2
◀ 12RP4	RD-C-CQ	12D	17 1/2
12TP4	RD-C	12D	18 3/4
12UP4 12UP4A 12UP4B	RD-C RD-G RD-G	12D	18 5/8
12VP4 12VP4A	RD-C RD-G	12G	18
14BP4	RT-G-EXT	12D	16 13/16
◀ 14CP4	RT-G-EXT	12D	16 3/4
14DP4	RT-G	12D	16 3/4
14EP4	RT-G-EXT	12D	16 1/2
◀ 14FP4	RT-G	12D	16 1/8
◀ 15AP4	RD-C-CD	12D	20 1/2
15CP4	RD-C	12D	21 1/2
◀ 15DP4	RD-C	12D	20 1/2
16AP4 16AP4A 16AP4B	RD-C RD-G RD-G-FF	12D	22 1/4
16CP4	RD-C	12D	21 1/2
16DP4 16DP4A	RD-C RD-G	12D	20 3/4
16EP4 16EP4A 16EP4B	RD-C RD-G RD-G-FF	12D	19 5/8
◀ 16FP4	RD-C	12D	20 1/4
16GP4	RD-G		

Picture Tube Data Chart

MAGNETIC FOCUS TYPES

DIMENSIONS (inches)		Deflection Angle (degrees)	Radius of Face Curvature (inches)	Envelope	Contact	Ion Trap Magnet	MAX. DESIGN CENTER VALUES		Comparative Focus Current (M A)
Outside Face Dimension	Min. Useful Screen Size						Anode Volts	Grid No. 2 Volts	
10 1/2	9 dia.	50	42	Glass	Cavity	Double	12,000	410	132
10 1/2	9 dia.	50	42	Glass	Ball	None	12,000	410	155
10 1/2	9 dia.	50	42	Glass	Ball	Double	12,000	410	132
10 1/2	9 dia.	50	42	Glass	Cavity	None	12,000	410	115
10 1/2	9 1/8 dia.	52	42	Glass	Cavity	Double	12,000	None	150
12	11 dia.	56	20	Glass	Ball	None	12,000	410	158
12 7/16	11 dia.	54	40	Glass	Cavity	None	12,000	410	140
12 7/16	11 dia.	54	40	Glass	Cavity	Double	12,000	410	114
12 7/16	11 dia.	54	40	Glass	Ball	Single	12,000	410	148
12	11 dia.	56	20	Glass	Ball	Single	12,000	410	148
12 7/16	11 dia.	54	40	Glass	Cavity	Double	12,000	410	114
12 7/16	11 3/8 dia.	54	27	Metal	Cone lip	Double Double Single	12,000	410	118
12 7/16	11 dia.	55	40	Glass	Cavity	Double	12,000	None	150
9 11/16 x 12 1/2	8 5/8 x 11 1/2	70 diag.	27	Glass	Cavity	Double	12,000	410	95*
9 11/16 x 12 1/2	8 5/8 x 11 1/2	70 diag.	27	Glass	Cavity	Single	14,000	410	95*
9 11/16 x 12 1/2	8 5/8 x 11 1/2	70 diag.	27	Glass	Cavity	Double	14,000	410	104*
9 11/16 x 12 1/2	8 5/8 x 11 1/2	70 diag.	27	Glass	Cavity	Single	14,000	410	105*
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15 1/2	14 dia.	57	45	Glass	Ball	None	15,000	410	159
15 1/2	14 dia.	57	45	Glass	Cavity	Double	15,000	410	133
15 1/2	14 dia.	57	45	Glass	Ball	Single	15,000	410	140
15 7/8	14 3/8 dia.	53	27	Metal	Cone lip	Double	14,000	410	89*
15 7/8	15 dia.	52	56 5/16	Glass	Cavity	Double	15,000	410	120*
15 7/8	15 dia.	60	60	Glass	Cavity	Double	15,000	410	115*
15 7/8	14 3/8	60	27	Metal	Cone lip	Double	14,000	410	105*
16 1/8	15 dia.	62	27	Glass	Ball	Single	16,000	410	140
15 7/8	14 3/8 dia.	70	40	Metal	Cone lip	Single	14,000	410	100*

IPMENT for MANUFACTURERS

Vacuum Gauge

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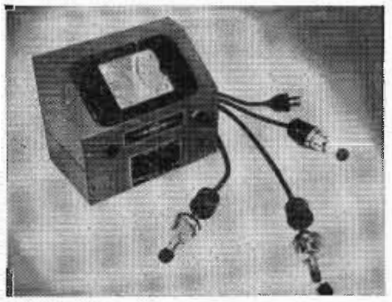

for laboratory or production instrumentation. Its design includes such features as noble metal thermopiles and nickel-plated pickup tubes. The nickel-plated pickup tubes afford freedom from outgassing, system contamination, and corrosion. With the switching attachment, as many as five stations per standard selector unit may be connected to each indicator. Matched gauge tubes eliminate the need for additional adjustment when switching. The calibration of the gauge tube is not affected by exposure to atmospheric pressure or changes in ambient temperature and there is no need to reset the current each time the pressure changes. The accuracy and quick response of the gauge make it ideally suited for leak detection warning work or pressure operated control systems.—**Hastings Instrument Co., Inc., Hamptou, Va.**—TELE-TECH

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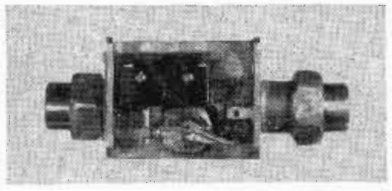
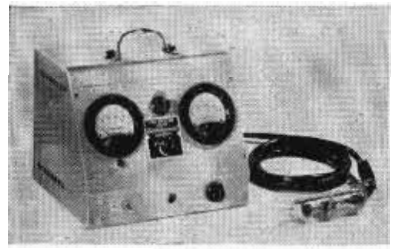
An improved flow interlock, a device which responds to a flow of water to open or close an electrical



contact, is now available. According to company engineers, the new design includes a finer differential, union fittings at hoth ends, a bronze piston, reduced size and weight, simpler adjustment, and more wiring space. In operation, the device closes a contact when a flow of water exceeds a preset amount and opens it when the flow falls below the preset amount. Working under this principle, it actually acts like a fuse in a circuit which depends upon water cooling for protection. The interlock can be used as a safety device in transformer cooling, induction heating, television luminaires and water-cooled dynamometers. Only one screw adjustment is needed to set the circuit for any flow from one-half gal. to four gal. per min. The flow differential between the cut-in and cut-out of the electrical contact is 0.1 gal. maximum. The new control is availahle complete with union fittings at each end, and a strainer attachment. The strainer keeps foreign matter out of the housing while the double union fittings simplify installation into a line. For strainer cleaning purposes, only one fitting need be removed. An enlarged switch housing makes wiring easy, and is protected from water damage by a triple-seal cork and chamois insulation.—**General Electric Co., Schenectady 5, N. Y.**—TELE-TECH

Leak Detector

Operating on the principle that the tendency of hot platinum to emit positive ions is enormously stimulated by infinitesimal traces of halogens or their compounds, a new and extremely sensitive inexpensive leak detector for use in vacuum systems down to one micron Hg has just been developed. The new detector (model LD-01) is expected to appeal to those who have only occasional need for a leak detector and whose purpose is merely to establish the presence of a leak too small to be detected by more obvious signs. In operation the glass sensitive tube of the leak detector is sealed into the system under test and the system is then pumped down to a moderate vacuum. A jet of harmless Freon gas, readily available in small cylinders, (or other halogen-containing gas) is then directed against portions of the system suspected of leaking. When the jet strikes a leak there is a sudden deflection of the meter needle on the instrument face, because the gas en-



tering the system instantly increases the ability of a hot platinum anode in the sensitive tube to emit positive ions. — **Distillation Products Industries, Div. of Eastman Kodak Co., Rochester, N.Y.**—TELE-TECH

Oscillator

Model M-2 Oscillator covers the frequency range of 1 to 120,000 cps in five overlapping bands. The circuit is

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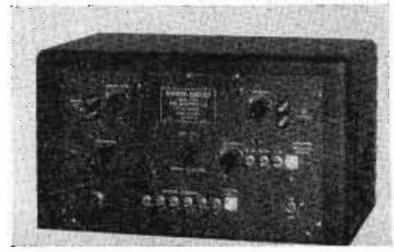
Wide Band Sweeping Oscillator

To speed up and at the same time give more accurate alignment of video and amplifiers over wide bands,



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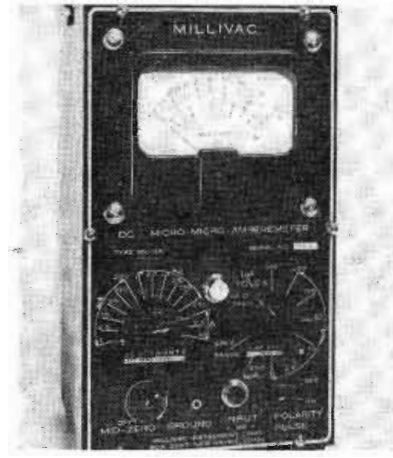

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10½	9⅛ dia.	52	42	Glass	Cavity	Double	12,000	None	150
12	11 dia.	56	20	Glass	Ball	None	12,000	410	158
12 7/16	11 dia.	54	40	Glass	Cavity	None	12,000	410	140
12 7/16	11 dia.	54	40	Glass	Cavity	Double	12,000	410	114
12 7/16	11 dia.	54	40	Glass	Ball	Single	12,000	410	148
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9 11/16x12½	8⅝x11½	70 diag.	27	Glass	Cavity	Double	12,000	410	95*
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15⅞	14⅜ dia.	53	27	Metal	Cone lip	Double	14,000	410	89*
15⅞	15 dia.	52	56 5/16	Glass	Cavity	Double	15,000	410	120*
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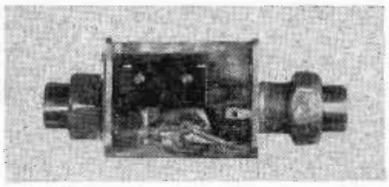

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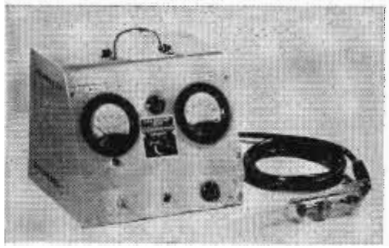

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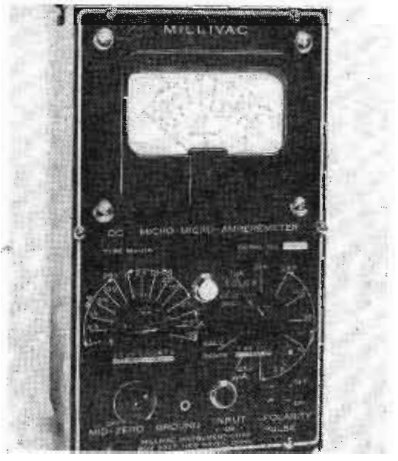

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15 7/8	14 1/2 dia.	52	56 5/16	Glass	Cavity	Double	14,000	410	95*
16 1/8	14 3/4 dia.	60	27	Glass	Cavity	Double	14,000	410	95*
11 1/2x14 3/4	10 1/8x13 1/2	70 diag.	27	Glass	Cavity	Double	16,000	410	130
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11 1/2x14 3/4	10 1/8x13 1/2	70 diag.	27	Glass	Cavity	Double	15,000	410	100*
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12 1/4x15 15/16	11x14 5/8	70 diag.	30	Metal	Cone lip	Single	16,000	410	95*
18 5/8	17 3/8 dia.	66	28	Metal	Cone lip	Single	19,000	410	140
18 7/8	17 3/8 dia.	66	60	Glass	Cavity	Double	19,000	410	140
13 3/16x17 1/16	12x16	70 diag.	27	Glass	Cavity	Double	19,000	410	95*
18 7/8	17 3/8 dia.	66	60	Glass	Cavity	Double	19,000	410	95*
18 7/8	17 3/8 dia.	66	60	Glass	Cavity	Single	19,000	410	100*
13 3/16x17 1/16	12x16	70 diag.	27	Glass	Cavity	Single	18,000	410	95*
20	18 3/4 dia.	54	30	Glass	Metal Cap	None	20,000	410	122
15 15/16x18 11/16	12 3/4x17	70 diag.	40	Glass	Cavity	Single	18,000	410	95*
15 15/16x18 11/16	12 3/4x17	70 diag.	40	Glass	Cavity	Single	18,000	410	95*
21 11/16	20 1/4 dia.	70	27	Metal	Cone lip	Single	19,000	410	105*
24 1/8	22 3/8 dia.	70	40	Metal	Cone lip	Single	16,000	410	100*
30 1/8	28 1/4 dia.	90	40	Metal	Cone lip	Single	30,000	410	95*

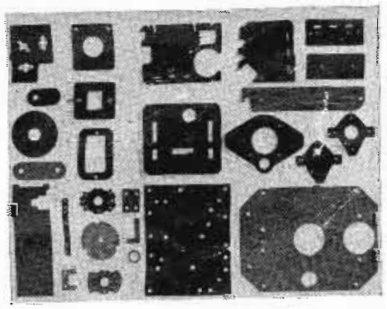
ROSTATIC FOCUS TYPES

DIMENSIONS (inches)		Deflection Angle (degrees)	Radius of Face Curvature (inches)	Envelope	Contact	Ion Trap Magnet	MAX. DESIGN CENTER VALUES		Comparative Focusing Electrode Volts
Outside Dimensions	Min. Useful Screen Size						Anode Volts	Focusing Electrode Volts	
21/4x15 3/8	10 3/4x14 1/4	70 diag.	27	Glass	Cavity	Single	18,000	5000	2300-3100
1/4x15 15/16	10 11/16x14 3/8	70 diag.	30	Metal	Cone lip	Single	16,000	4500	2300-3100
5/16x18 11/16	12 3/4x17	70 diag.	40	Glass	Cavity	Single	18,000	5000	2300-3200
5/16x18 11/16	12 3/4x17	70 diag.	40	Glass	Cavity	Single	18,000	5000	2400-3200

)UCTS for DESIGN ENGINEERS

Stampings

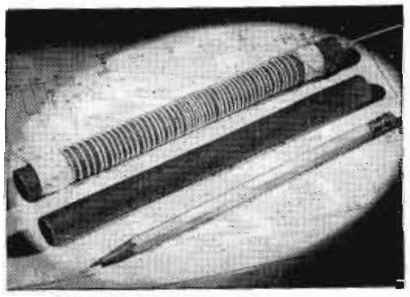
Short-run stampings of phenolic resins, vulcanized fibres, plastics, insulation paper (fish paper) and other



non-metallic materials are now available. Stampings for radio chassis, insulators, spacers, panels, or gaskets, spacers or cams are made to specifications in any dimensions up to 9 x 12 x ⅛ in. thick. Stampings may be obtained in any quantities from 3 pieces to 2,000.—**Federal Tool and Manufacturing Co., Dept. TT, 3600 Alabama Ave., St. Louis Park, Minneapolis, Minn.**—TELE-TECH

Metal-Core Antenna System

Not much larger than a lead pencil, the "Croloy Radio Rod" coil serving as an antenna system not only



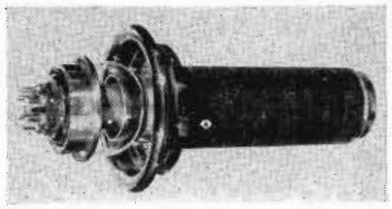
improves reception but saves space in the radio set. Signal-to-noise ratio is greatly increased, thereby reducing objectionable man-made static or background noise. The "Croloy Radio Rod" antenna utilizes a Croloy rod or tube. Croloy Radio Rods are in production from .250 to .6 in. diameter, but facilities can take care of anything up to 1½ in. diameter. Also, Croloy can be furnished in square rods and tubing, and in fluted or serrated cross-sectional shapes for minimum contact with the wire winding. The material is manufactured in various lengths, and present cores average 7 to 8 in. long. With a single layer winding of insulated wire, the Croloy antenna assembly is used in place of the conventional outside antenna or the built-in loop. Signal pickup is considerably better than that of the usual air loop, or of the order of 2:1 at the low end of the broadcast band, and about equal at the high. Q's above 200 are easily obtainable with law cost solid wire. Because of its amazing compactness —not much larger than a lead pencil —the Croloy Radio Rod antenna can be mounted anywhere in the receiver cabinet, in a minimum of space.—**Henry L. Crowley & Co., Inc., West Orange, N. J.**—TELE-TECH

Laminated Plastic

A new laminated plastic has been designed for 60-cycle work. To be known as Z-80, the new Formica insulating material combines in one grade three useful properties: high arc resistance, good dimensional stability, low power loss at 60 cps. In addition, it is said to have good punching and excellent machining qualities. Z-80 is made of a coarse weave fabric, bonded with arc resistant resin. It is available in sheet form from 1/32 to 1 in. thick, natural color, semi-gloss finish. It can be laminated-molded to a wide variety of shapes.—**The Formica Co., 4644 Spring Grove Ave., Cincinnati 32, Ohio.**—TELE-TECH

Transmitter and Power Tubes

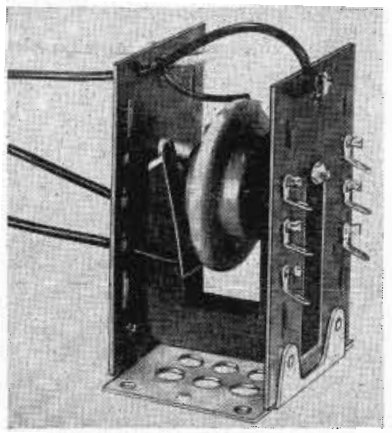
Air-cooled transmitting and power tube, type AX-9906R/6078, has a plate dissipation of 45KW and weighs only



66 lbs. This remarkably high ratio of plate dissipation to weight is obtained by virtue of the fact that new, high efficiency radiator fins and a unique air flow chamber are employed. High velocity air is diverted in the assembly into a number of parallel paths, thus minimizing the total pressure. Designed for high power transmitter applications, the triode produces an output of 108 KW to 15 MC and is intended for operation up to a maximum frequency of 30 MC. Maximum plate voltage is 13,500 volts and maximum plate current is 12 amps. Type AX-9906/6077 is the water-cooled version of this tube, with an available plate dissipation of 100 KW.—**Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N.Y.**—TELE-TECH

Flyback Transformer

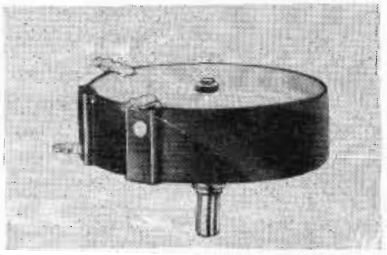
A new high-efficiency RAM XO45 Flyback Transformer is being produced for replacement and conversion



purposes. Precision-constructed, the new unit is specifically designed as a replacement transformer for all TV receivers originally using 1B3 or 6BG6 tubes. For 16-in. and 20-in. round and rectangular tubes, it generates 12.5-14 KV and 13.5 KV respectively, with horizontal sweep more than ample for 20 in. picture tubes.—**RAM Electronics, Inc., South Buckhout St., Irvington-on-Hudson, N. Y.**—TELE-TECH

Electrostatic Focusing Control

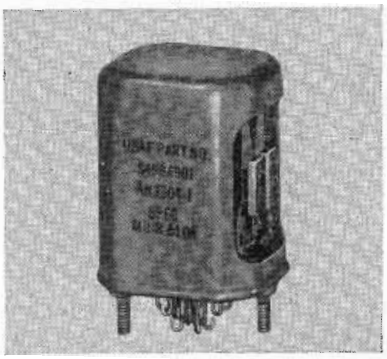
A new high voltage control (Type 85) for electrostatic focusing now enables TV manufacturers to conserve



substantial amounts of Alnico V magnets and copper wire and still produce more sets for civilians. This unique control is made chiefly of insulating materials, using a minimum amount of metal, and has been developed for the new high voltage electrostatic focusing video tubes.—**Chicago Telephone Supply Corp., Elkhart, Ind.**—TELE-TECH

Telephone-Type Relays

These hermetically-sealed relays are available in contact forms up to and including 4-pole double-throw, 3-



amp, 28-volt dc construction. They are also manufactured in 10 amp ratings up to and including 2-pole double throw at 28 volts dc. All relays can be provided with an approved AN plug connector or solder connections.—**R-B-M Div., Essex Wire Corp., Logansport, Ind.**—TELE-TECH

Silver-Clad Steel Strip

A laminated strip product consisting of a solid sheet of silver (not an electroplating), clad on either one or both sides of a core of mild steel, bas been developed. This strip is available in widtbs up to 4 in. in thicknesses down to .005 in., and in any required temper. It is being manufactured in various silver-to-steel thickness ratios and rolled and slit to commercial or precision tolerances. The strip is produced with a high, as-rolled lustre which required practically no polishing, and can, if desired, be electroplated directly with gold or other nonrestricted metals. Silver-clad steel may be used as a substitute for brass, nickel-silver, nickel, and other restricted metals, subject to N.P.A. Order M-47. It can be shaped by stamping, bending, drawing, spinning, and other conventional metal-working processes, and component parts can be assembled by means of silver brazing or soft soldering.—**American Silver Co., Inc., Rolled Plate Div., Flushing, N. Y.**—TELE-TECH

OUTLINE INFORMATION

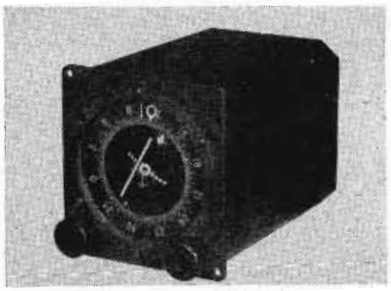
OTE: All bulb outline information is given in inches. Unless otherwise stated out- n for "A", "B", "C", or "D" types is identical to that given for the basic type.

F	G	H
5/16		
	2 3/4	∞
	2 3/4	∞
	2 3/4	∞
	2 3/4	∞
	2 3/4	∞
7/8		
7/8		
1/2		
	3 1/4	∞

Basic Type	See Outline	A	B	C	D	E	F	G	H
16MP4	A	13 1/4	7 1/2	7 15/16					
16QP4	C	11 1/4	7 7/8	7 5/8	∞			3 1/4	∞
16RP4	C	11 1/4	7 1/2	7 5/8	∞			3 1/4	∞
16SP4	A	10 5/16	7	7 7/16					
16TP4	C	11 1/4	6 7/8	7 5/8	∞			3 1/4	∞
16UP4	C	11 1/4	6 7/8	7 5/8	∞			3 1/4	∞
16VP4	A	10 5/16	6 7/8	7 1/4					
16WP4	A	10 5/16	7 1/2	7 7/16					
16XP4	C	11 1/4	7 1/2	7 5/8	∞			3 1/4	
16YP4	A	10 5/16	7	7 7/16					
16ZP4	A	14 7/8	7 3/8	7 7/16					
17AP4	C	11 3/4	6 7/8	7 1/8	21			2 5/8	27
17BP4	C	11 3/4	7 1/2	7 1/8	21			2 5/8	27
17CP4	C&D	11 5/16	7 3/16		26 1/2	8	3/4	3 3/8	28 5/16
17FP4	C	11 3/4	7 1/2	7 1/8	21			2 5/8	27
17GP4	C&D	11 5/16	7 3/16		26 1/2	8	3/4	3 3/8	28 5/16
19AP4	B	14 3/8	7 1/8			9 1/8	1 3/8		
19DP4	A	14 3/8	7 1/8	7 3/16					
19EP4	C	13 5/8	7 1/2	10	∞			2 1/2	∞
19FP4	A	14 3/8	7 5/8	8 1/16					
19GP4	A	14 3/8	6 7/8	8 1/16					
19JP4	C	13 5/8	7 3/16	10	∞			2 1/2	∞
20BP4	A	20	8	14					
20CP4	C	14 1/4	7 3/16	7 1/2	26 1/2			3 9/16	34 3/32
20DP4	C	14 1/4	7 1/2	7 1/2	26 1/2			3 9/16	34 3/32
20FP4	C	14 1/4	7 1/2	7 1/2	26 1/2			3 9/16	34 3/32
20GP4	C	14 1/4	7 1/2	7 1/2	26 1/2			3 9/16	34 3/32
22AP4	B	15 5/8	7 1/4			11 5/16	1 7/8		
24AP4	B	15 11/32	6 27/32			16 3/4	1 7/16		
30BP4	B	14 1/16	7 3/16			11 7/32	2 5/16		

Course Line Indicator

The course line indicator gives the pilot a clear and unmistakable picture of his position with respect to his chosen course. No interpretation of the presentation is required as the indicator simulates the situation exactly as though the pilot could see



his selected course marked on the ground below. It presents: displacement information with respect to a selected omni range of localizer course; aircraft compass heading information and deviation from a selected compass course; to-from information with respect to an omni range station; bearing information to or from an omni range station. The indicator also provides for selection of omni range bearings and for selecting any desired compass heading —**Collins Radio Co., Cedar Rapids, Iowa**—TELE-TECH

VHF Ground Station

A ground VHF communication station has been designed for use by fixed base operators. The new compact unit, which does not require any special installation, is small, attractively finished and can be set up anywhere for use by airport operators, feeder airlines and similar operations which have a requirement for reliable VHF communications. Both the VHF transmitter and receiver are crystal controlled to assure maintenance of proper frequency, usually 122.8 MC.—**National Aeronautical Corporation, Wings Field, Ambler, Pa.** — TELE-TECH

Ceramic Components

Four new ceramic components have been developed. Model LS-7 is a slug tuned coil form assembly. Its coil form grade is L-5 silicone impregnated ceramic. Form diameter is ½ in. There are adjustable ring terminals and a spring lock for slug. The unit mounts in single ¼ in. hole. It is supplied complete with all mounting hardware and high, medium or low frequency slug. All metal parts are non-ferrous, heavily plated to withstand severe service conditions. The LS-8 is a slug tuned coil form featuring silver-plated phosphor bronze clip terminals which cannot loosen. Height is $^{23}/_{32}$ in. and maximum diameter is ½ in. It mounts in "D" punched hole or in ¼ in. round hole. Coil form is of grade L-5 silicone impregnated ceramic. Slug is provided with a spring lock. All metallic parts except clips are cadmium plated. The X1990 is a feed-through insulator. Grade L-5 silicone impregnated ceramic is used Overall length is ⅞ in. including terminal. Voltage breakdown is rated 4800 volts RMS at 60 cps ac. Model X1986 is a terminal board. It, too, uses grade L-5 silicone impregnated ceramic. Mounted height including terminals is $^{31}/_{64}$ in.; length, 1¼ in.; width, ⅞ in. The assembly has eight C.T.C. type X1558 terminals in 2 rows (4 per row), 9/16 in. apart, plus two 4-40 tapped standoffs 5/16 in. high on ⅝ in. centers. A center ground strap is provided to which standoffs are riveted and soldered for good grounding at r-f frequencies. All metal parts are non-ferrous, heavily plated. — **Cambridge Thermionic Corp., 439 Concord Ave., Cambridge, Mass.**—TELE-TECH

Splicing Block

A new and greatly improved splicing block for use in editing N.A.B. standard ¼" magnetic tape is now available. The tape is held in a groove, which is machined to extreme accuracy with a curved bottom, and is designed to grip the tape snugly, without mechanical aids. By eliminating time-consuming holding clips or other devices, the operator may attain much greater speed. The block is made from Duraluminum and can easily be fastened on any recording machine of any other place where the work is performed. It is designed to be used with Minnesota Mining's #41 splicing tape especially furnished in 1/32 in. width.—**Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.**—TELE-TECH

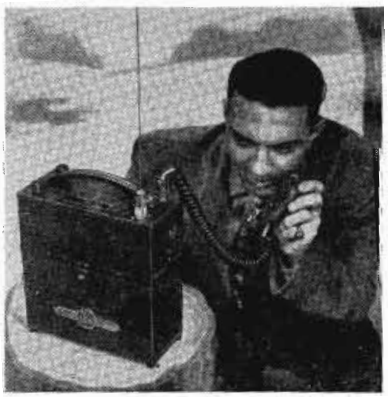
Microphone

The small Unidyne, model 558 (right) is an ultra-cardioid microphone approximately one-half as large as its companion in the Shure line, the standard Unidyne model 55. The small version retains all the important directional qualities of the Model 55, and is offered as the only small-size uni-directional moving-coil dynamic microphone. The moving coil system has a high overall efficiency and smooth frequency response. A large air-gap clearance and a

rugged coil construction provide immunity of the moving coil system to abnormal atmospheric conditions and severe mechanical shock. — **Shure Brothers, Inc., One N. LaSalle, Chicago 2, Ill.**—TELE-TECH

Radio-Telephone

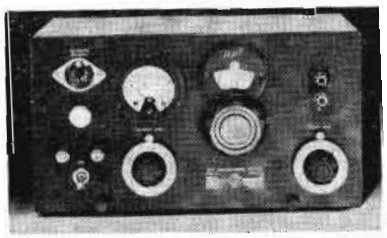
A new improved portable FM two-way radio-telephone unit, which can be either hand-carried or back-



packed, has been developed. Known as the Link pack set type 3035, it is a complete portable assembly for operation in the 25-50 MC VHF band. Weighing 19 pounds, it has a standard battery complement which provides as much as 50 to 100 hours of intermittent transmitting and receiving service. The r-f power output is about ¾ watt from the 152-174 MC transmitter and over 1 watt from the 25-50 MC transmitter. Audio output into an in-the-case loudspeaker is 1 watt. Receiver sensitivity in both bands is 1 microvolt for 20 db quieting. Suitable antennas are supplied with each pack set.—**Link Radio Corp., 125 West 17th St., New York 11, N. Y.** —TELE TECH

R-F Capacitance Meter

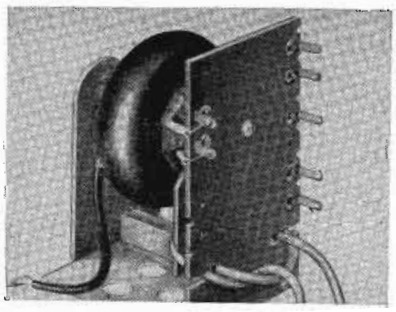
Capacitances from a few hundredths of a mmf to 100 mmf are easily and quickly measured on the type 1612-AL-R-F capacitance meter. Two ranges, 0 to 10 mmf and 0 to 100 mmf,



are provided and are switched automatically by rotating the main capacitance dial. The instrument has a self-contained 1 MC oscillator and resonance indicator. The measurement of tube-socket capacitances as covered by the recent RTMA standard TR-111 are accurately and conveniently measured on the 1612-AL by means of socket adaptors which are available. An additional feature not specified in the standard is a rough indication of the losses in the socket dielectric. The instrument is not limited to measurements on sockets but is useful for measuring ceramic, molded mica, or variable air capacitors of all types.—**General Radio Company, 275 Massachusetts Ave., Cambridge 39, Mass.**—TELE-TECH

Horizontal-Deflection-Output & High-Voltage Transformer

The new horizontal-deflection-output and high voltage transformer RCA-225T1 is offered for use with the 17CP4, 19A-types, 20CP4, and similar picture tubes having a horizontal deflection angle of about 66° and operating at a zero-load anode potential of 16 KV. The 225T1, utilizing a ferrite core for high efficiency, light weight, and compactness, is designed



for use with a single, horizontal-deflection amplifier tube which may be either a 6BQ6-GT or a 6AU5-GT; a single, high-voltage rectifier tube such as the 1B3-GT; and the magnetic deflecting yoke RCA-209D1 which also has a ferrite core. In properly designed circuits, the 225T1 can supply up to 16 KV at no load, has good regulation, and can provide good deflection linearity.—**Radio Corporation of America, Tube Dept., Harrison, N.J.** —TELE-TECH

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JUNE, 1951

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COVER: **Lt. K. L. Broga, radar navigator,** of the 31st Strategical Reconnaissance Squadron is shown operating the radar equipment aboard an RB-29 while over North Korea. This member of the combat crew is the main link in the flying of an accurate and precise photo flight line. See page 42.

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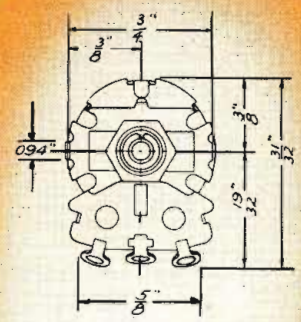

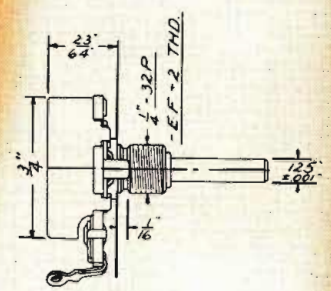

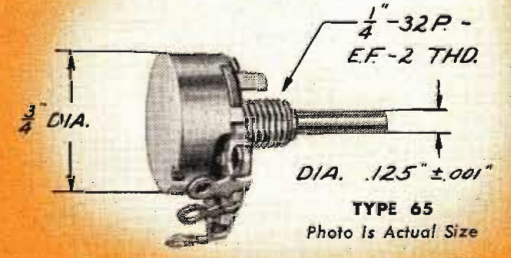

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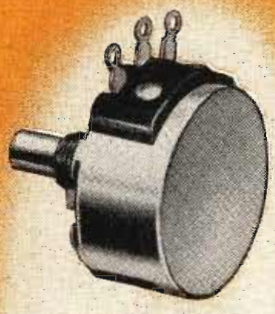
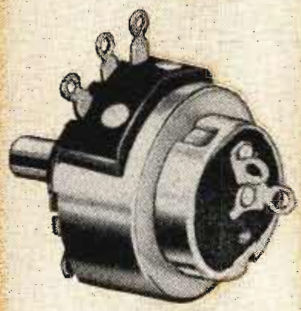
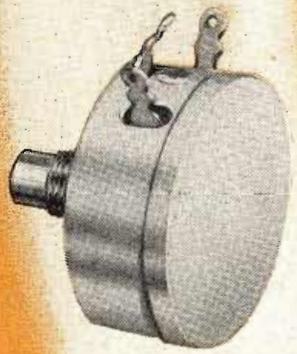


JAN Type RA 20A
2 Watt (CTS Type 252)



JAN Type RA 20B
2 Watt (CTS Type GC-252)



JAN TYPE RA 25A
3 Watt (CTS Type 25)

Meets JAN-R-19

VARIABLE WIRE WOUND RESISTORS TO ALL SPECIFICATIONS IN JAN-R-19

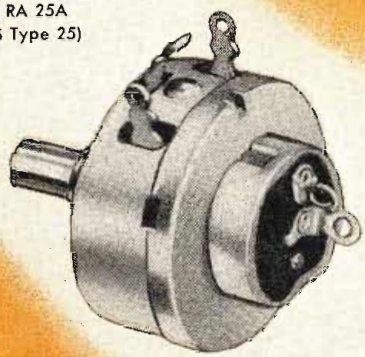
TYPES NOW AVAILABLE

JAN TYPE	CTS TYPE	WATT RATING
RA 20A	252 (without switch)	2
RA 20B	GC-252 (with switch)	2
RA 25A	25 (without switch)	3
RA 25B	GC-25 (with switch)	3
RA 30A	25 (without switch)	4
RA 30B	GC-25 (with switch)	4

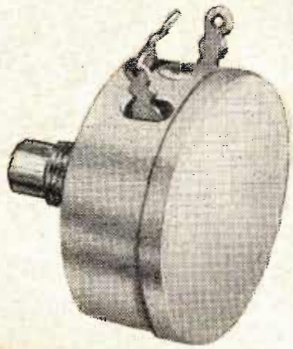
Exceptionally good delivery cycle due to tremendous precision mass production facilities.

Please give complete details on your requirements when writing or phoning for further information.

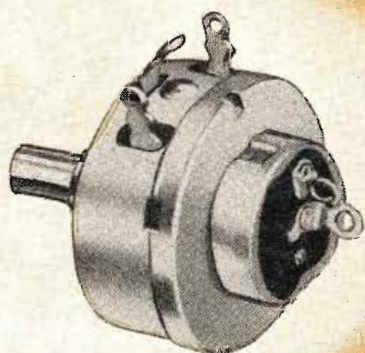
ILLUSTRATIONS ARE ACTUAL SIZE.



JAN Type RA 25B
3 Watt (CTS Type GC-25)



JAN Type RA 30A
4 Watt (CTS Type 25)



JAN Type RA 30B
4 Watt (CTS Type GC-25)

A COMPLETE LINE OF VARIABLE RESISTORS (COMPOSITION AND WIRE WOUND) FOR MILITARY APPLICATIONS.

Specialists in Precision Mass Production of Variable Resistors

FOUNDED 1896

CHICAGO TELEPHONE SUPPLY *Corporation*

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OTHER EXPORT

Sylvan Ginsbury
8 West 40th Street
New York 18, N. Y.

For Negative Resistance-Voltage Characteristics

GLOBAR
TRADE MARK

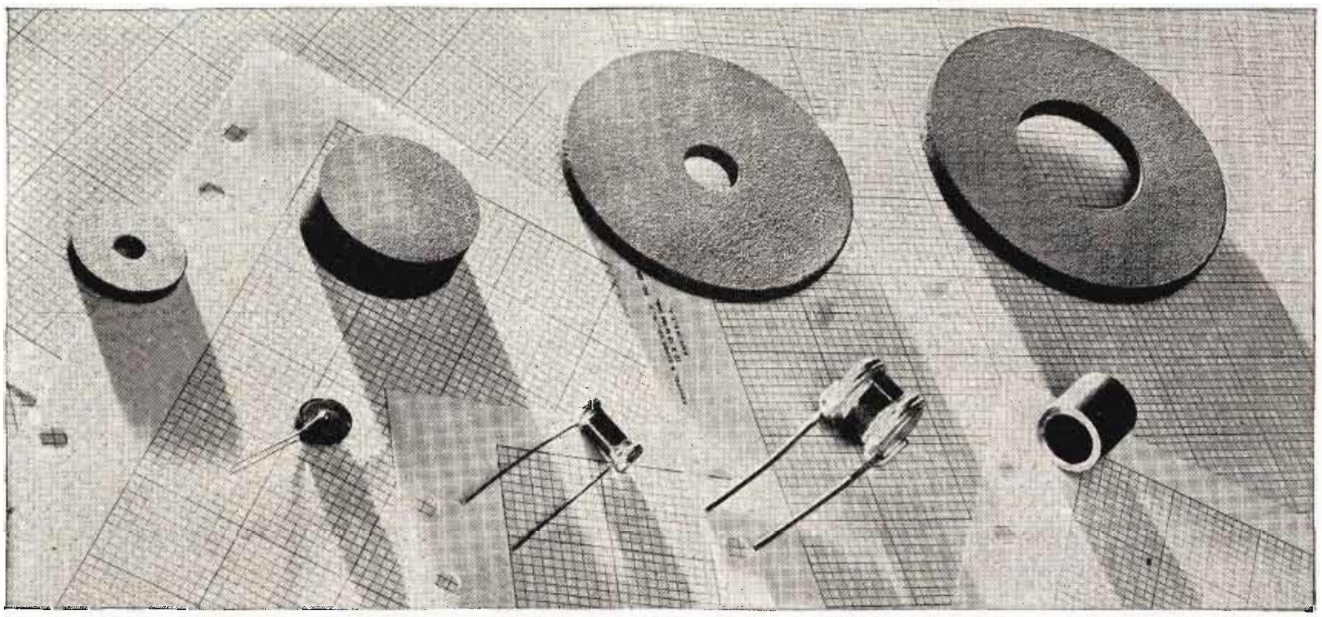
TYPE BNR RESISTORS

Typical applications where these resistors operate successfully include:

1. Small motors to prevent arcing of governor contact points.
2. Stabilizing rectifier circuits by limiting peak voltages.
3. Voltage control circuits in electronic devices.
4. Protection of solenoids in direct current circuits.

Responding instantly to voltage changes, GLOBAR type BNR Silicon Carbide Resistors provide increased resistance as a potential is decreased. Conversely, as a potential is applied, resistance decreases. These resistors are what is commonly referred to as voltage sensitive. They are used to dampen the effect of transient voltages and provide instant protection for electrical circuits.

Bulletin GR2 contains useful engineering data on GLOBAR BNR Ceramic Resistors. Copies will be supplied immediately upon request. Write Dept. T-61, The Carborundum Company, GLOBAR Division, Niagara Falls, N. Y.



Resistors of this type are readily made to meet exact specifications. Working samples are available when necessary. To be sure of receiving resistors made to correct specifications, the following information should be furnished:

a. Type of apparatus in which resistors are to be used.
b. Method of mounting and space limitations.
c. Normal operating voltage and peak voltage if available.
d. Resistance and inductance of the circuit if available.
e. Ohmic resistance of the resistor and allowable plus or minus tolerance.
f. Maximum voltage applied continuously or intermittently.
g. Duration of load and elapse of time between applications.

Furnishing these data will also avoid unnecessary delay and confusion.

GLOBAR Ceramic Resistors BY CARBORUNDUM
TRADE MARK

"Carborundum" and "Globar" are registered trademarks which indicate manufacture by The Carborundum Company, Niagara, Falls, N. Y.

this is it!

UP
The TL-10 in raised position allows discs to be played

DOWN
The TL-10 mounted and ready for perfect tape reproduction

new PRESTO Turntable Tape Reproducer

When we introduced the PRESTO TL-10 at the IRE, NARTB and Parts Show this spring we knew it was good—and we knew that there was a place for it in the nation's stations, recording studios and schools.

But we never realized just *how* popular it would be. This inexpensive turntable tape reproducer has turned into the sensation of the industry—and here are a few of the reasons why!

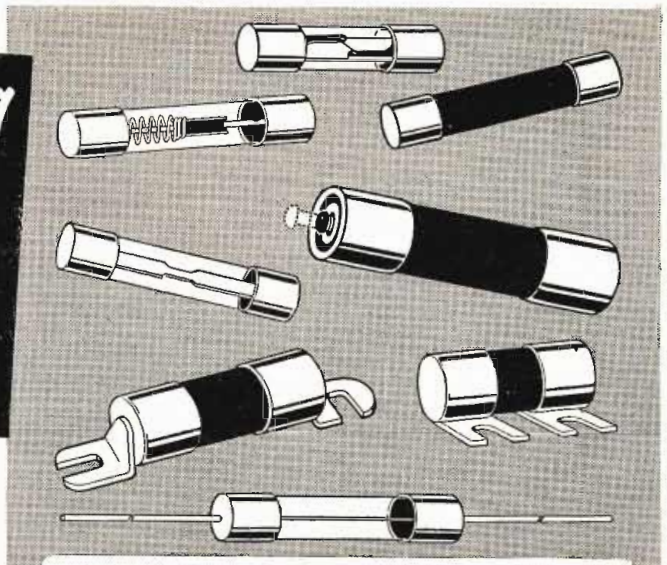
- Easy to attach to and remove from any standard 16" turntable.
- No motor—turntable acts as motor.
- Can be plugged into any standard speech input equipment.
- Speeds of 7½" and 15" per second, response up to 15,000 cps.
- Low cost—but has reproduction quality and fidelity of a high priced machine.
- Easy to operate—and maintain.

If you haven't ordered your TL-10 already, do it today. Its addition to your studio will save you time . . . space . . . and money!

PRESTO
RECORDING CORPORATION
PARAMUS, NEW JERSEY

Export Division: 25 Warren Street, New York 7, N. Y.
Canadian Division: Walter P. Downs, Ltd., Dominion Square Bldg., Montreal

When you need a FUSE—think of BUSS



THE MOST COMPLETE LINE OF FUSES FOR THE *Electronic Industries*

- RADIO
- TELEVISION
- RADAR
- INSTRUMENTS
- CONTROLS
- AVIONICS

Whatever your needs in electrical protection there's a Buss fuse made to fit.

Send for Bulletin SFB—showing full line of fuses and fuse mountings.

A complete line of fuses made to dimensions smaller than National Electrical Code fuses.

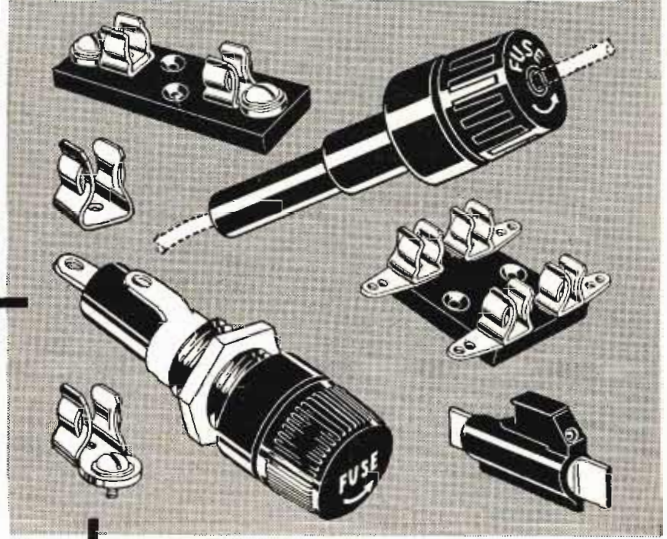
These fuses are SPACE SAVERS.

They are particularly well suited to the protection of instruments, radios, television and electronic equipment of all kinds, aircraft, automobiles, coin-operated devices and any apparatus where space for the protective device is at a premium.

Fuses of the Dual-Element, Renewable and One-Time type are available.

Companion lines for FUSETRON and BUSS small dimension fuses are BUSS Fuse Clips, Blocks and Fuse Holders. They are made in many types and sizes to make it easy to select the fuse and fuse-mounting needed to give the required protection.

For full information ask for the BUSS Bulletin on Small Dimension Fuses and Fuse Holders — Form SFB.



SPECIAL FUSES, FUSE CLIPS, FUSE BLOCKS and FUSE HOLDERS

Sometimes a special fuse or fuse mounting is required. In such cases we welcome your requests either to quote—or to help in designing or selecting the special type of fuse or fuse mounting best suited to your particular conditions.

Submit description or sketch, showing type of fuse to be used, number of circuits, type of terminal, etc. If your protection problem is still in the engineering state, tell us current, voltage, load characteristics, etc.

At any time our staff of fuse engineers is at your service to help solve your problems in electrical protection.

USE THIS COUPON— *Get all the facts*

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.) **TT-650**

Please send me Bulletin SFB containing complete facts on Buss Small Dimension Fuses.

Name_____

Title_____

Company_____

Address_____

City_____ State_____

Compactness

for resistors

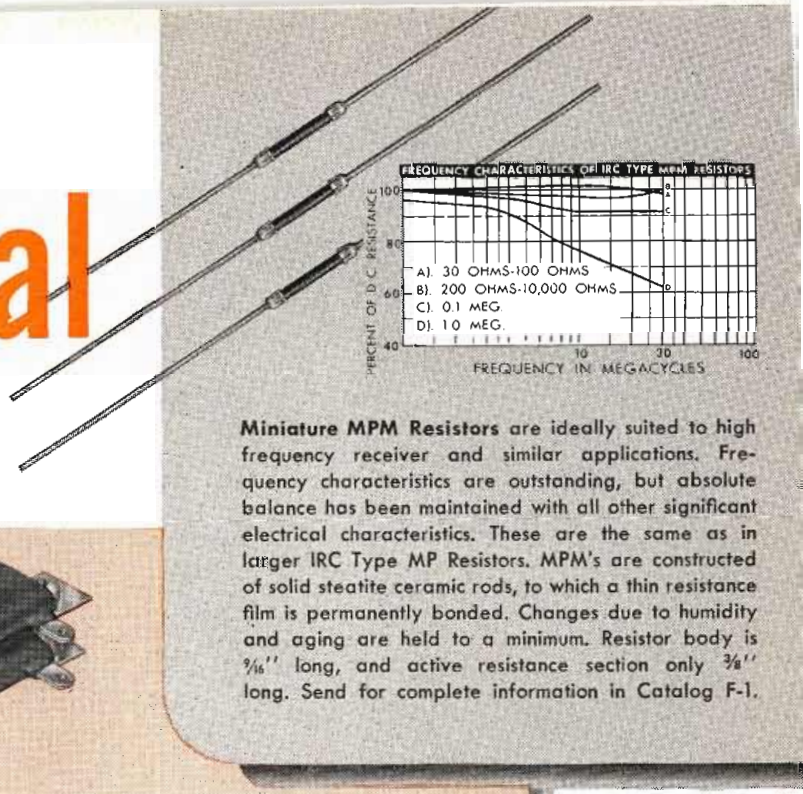
More and more components in less and less space! That's the manufacturer's dilemma as necessity shrinks the size of electrical and electronic instruments and equipment.

But compactness need not create bottlenecks —if you specify IRC *miniature resistors*. Years ago, we foresaw the trend to compactness and got ready for it. Now, with the widest line of resistor types in the industry, IRC can supply miniature components for almost any application.

Only 15/16" in diameter, compact new IRC Type Q Controls adapt to a wide variety of small-space applications. Rugged construction features one-piece dual contactor of thin, high-stress alloy—simplified single-unit collector ring—molded voltage baffles—special brass element terminals that will not loosen or become noisy when bent or soldered. Salt-spray materials, when specified, protect against humidity; change in resistance is negligible even after long exposure. Noise level is low and Type Q Controls have unusual durability and efficiency. Coupon brings you full details in Catalog A-4.

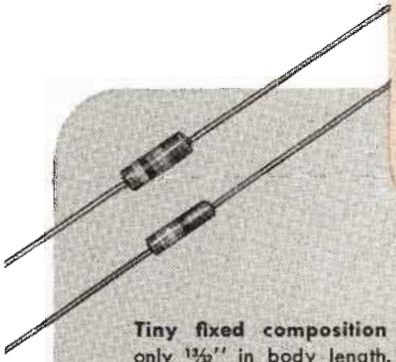
is essential

too!



Miniature MPM Resistors are ideally suited to high frequency receiver and similar applications. Frequency characteristics are outstanding, but absolute balance has been maintained with all other significant electrical characteristics. These are the same as in larger IRC Type MP Resistors. MPM's are constructed of solid steatite ceramic rods, to which a thin resistance film is permanently bonded. Changes due to humidity and aging are held to a minimum. Resistor body is 9/16" long, and active resistance section only 3/8" long. Send for complete information in Catalog F-1.

Higher space-power ratio than tubular wire wounds suits small, flat Type FRW fixed and adjustable wire wounds to voltage dropping applications in limited space. FRW's may be mounted vertically or horizontally, singly or in stacks. Non-magnetic mounting brackets extend through resistors—allow easy and economical mounting—aid in heat distribution along entire length—and transfer internal heat to chassis. Light-weight construction combines with exceptional mechanical strength and ability to withstand severe vibration. Bulletin C-1 gives full performance data.



Tiny fixed composition resistors—Types BTR and BTS—are only 13/32" in body length. At 1/2 and 1/2 watts, respectively, these miniature units set new performance standards for fixed composition resistors. Advanced BT's easily meet the rigorous requirements of television—actually exceed JAN-R-11 Specifications! Balanced in every characteristic, BT's are especially well suited to high ambient temperatures. Power dissipation is excellent. Other Advanced Type BT's meet and surpass JAN-R-11 Specifications at 1 and 2 watts. Write for full particulars in Catalog B-1.

When you're squeezed for "small-orders" of standard resistors in a hurry, simply call your IRC Distributor. IRC's Industrial Service Plan enables him to give you fast, 'round-the-corner delivery of standard resistors for experimental work, pilot runs, maintenance. We'll be glad to send you his name and address.

IRC

INTERNATIONAL RESISTANCE COMPANY
PHILADELPHIA 8, PENNSYLVANIA
In Canada: International Resistance Company, Ltd., Toronto, Licensee

Wherever the Circuit Says

Power Resistors • Voltmeter Multipliers • Insulated Composition Resistors • Low Wattage Wire Wounds • Volume Controls • Voltage Dividers • Precision Wire Wounds • Deposited Carbon Precistors • Ultra-HF and High Voltage Resistors • Insulated Chokes

INTERNATIONAL RESISTANCE COMPANY
407 N. Broad St., Phila. 8, Pa.

Send me additional data on the items checked below:—

- ☐ Q Controls
- ☐ Flat FRW Resistors
- ☐ Advanced BT Resistors
- ☐ MPM Resistors
- ☐ Name and Address of local IRC Distributor

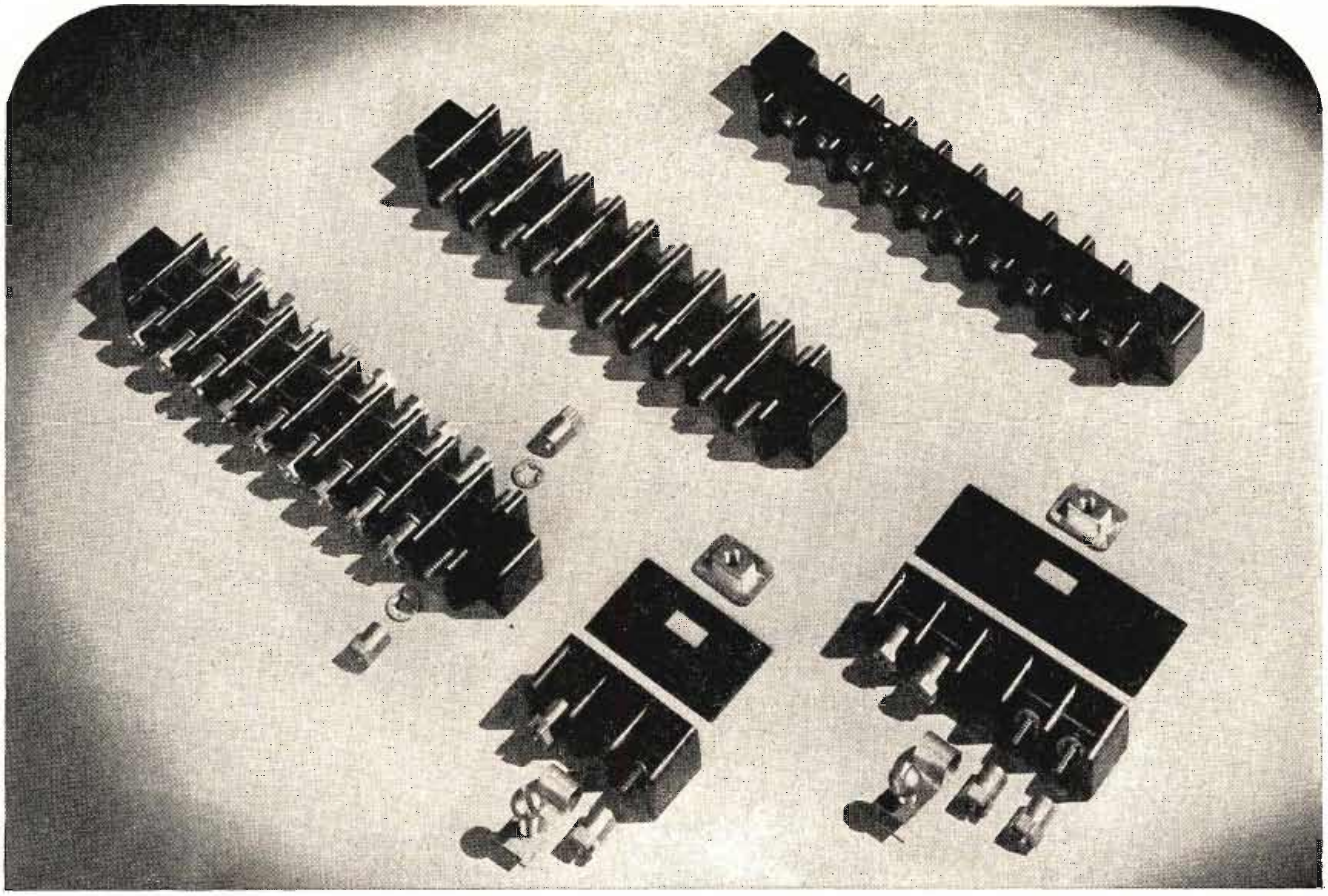
NAME.....

TITLE.....

COMPANY.....

ADDRESS.....

J. F. ARNOT & CO., ADV. AGENCY



HOW TERMINAL BLOCKS DEVELOPED FOR NAVY . . .

. . . can save you space, installation time, servicing costs

Now available to manufacturers for their own products, these Army-Navy approved terminal blocks were developed for maximum strength, high voltage insulation and convenience in making connections in smallest possible space. They are designed to eliminate non-functional material—take maximum advantage of minimum space.

Installation is quick, easy, with segregated individually accessible connections.

We can supply with or without related hardware. Examination of a sample will convince you that it is the highest quality precision-made terminal block on the market today.

SHAW

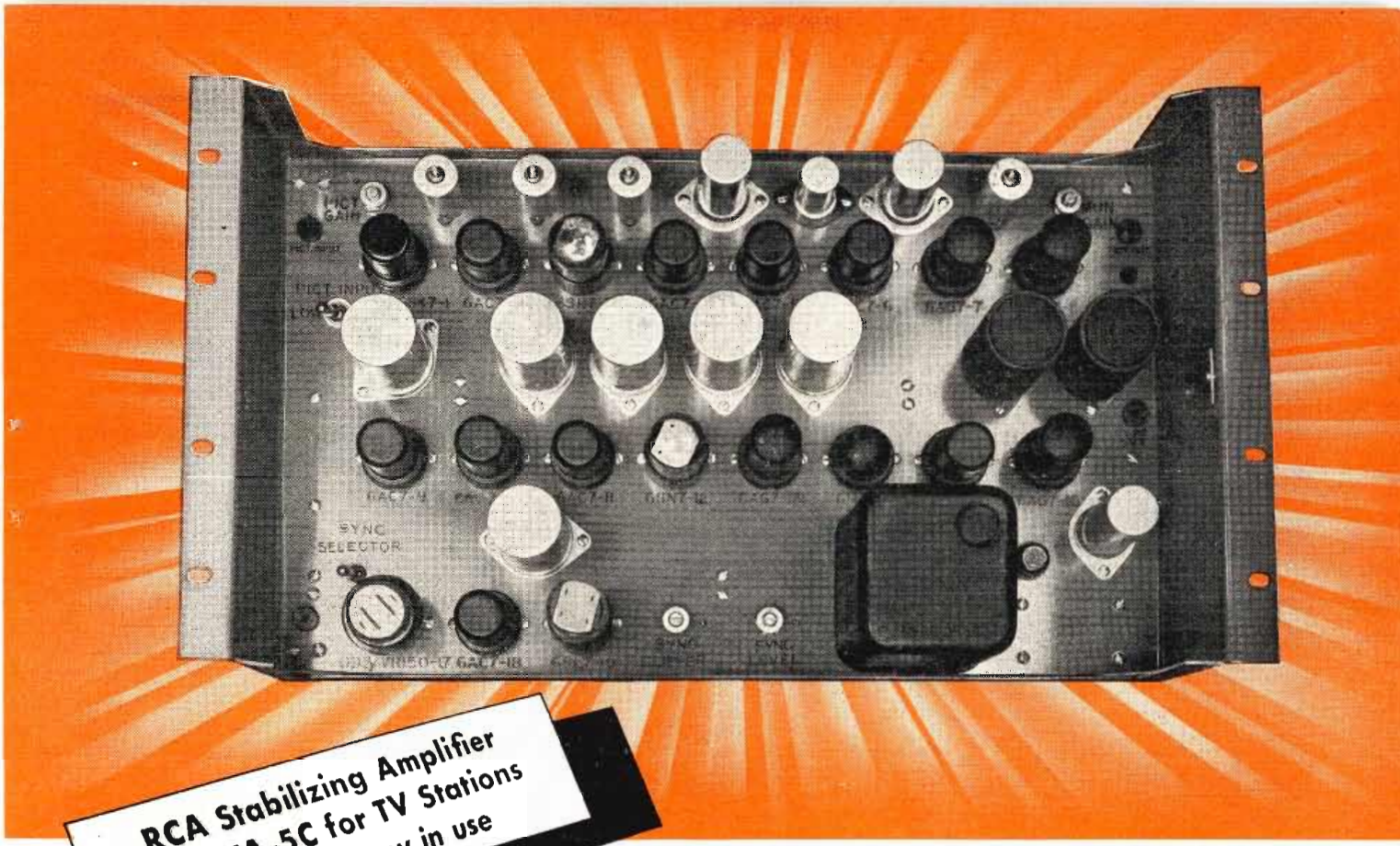
SHAW INSULATOR COMPANY

160 COIT STREET IRVINGTON 11, N. J.

SEND FOR LITERATURE

We will be glad to supply you with descriptive literature, specifications and prices by return mail.

MOLDERS QUALITY MARK ON MOLDED PLASTICS SINCE 1892



RCA Stabilizing Amplifier
Type TA-5C for TV Stations
Over 400 now in use

Best in the Business
—take stability, for instance

• Stability—the most necessary requirement of any stabilizing amplifier—is a "standout" feature of the TA-5C. It is absolutely stable under all operating conditions. It operates with the same stability with or without signal input. It provides complete isolation between monitors—makes it possible to perform on-air monitor switching operations without creating transients or cross-talk on the program line.

The TA-5C stabilizing amplifier handles sync inputs up to 8 volts—and delivers signal voltage output at standard RMA values through just one simple adjustment of the sync control. Total tube complement—only 19!

Today more than 400 RCA Stabilizing Amplifiers are helping TV stations deliver the cleanest, most stable pictures in the history of commercial television. *Need we say more?*

* * *

Call your RCA representative for price and information on delivery. Or mail the coupon—today.

RCA

TELEVISION BROADCAST EQUIPMENT
RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

Dept. R-87
RCA Engineering Products
Camden, N. J.

Send me price and complete information on the RCA Type TA-5C Stabilizing Amplifier.

Name_____

Address_____

City_____ State_____

Station_____

TELE-TIPS

FIELD INTENSITY measuring test parties should not be worried if cold mornings produce higher readings than the last ones taken in the same place the night before. Recent reports of investigations made over as long as ten years by Stuart Bailey, the well-known consulting engineer, prove that within three to five miles from the antenna the ground wave is strongly affected by temperature variations — the proximity to the antenna rules out the possibility of skywave effects. This may precipitate another demand by sponsors for a summer rate reduction on grounds of reduced efficiency, and the FCC might demand summer and winter DA checks!

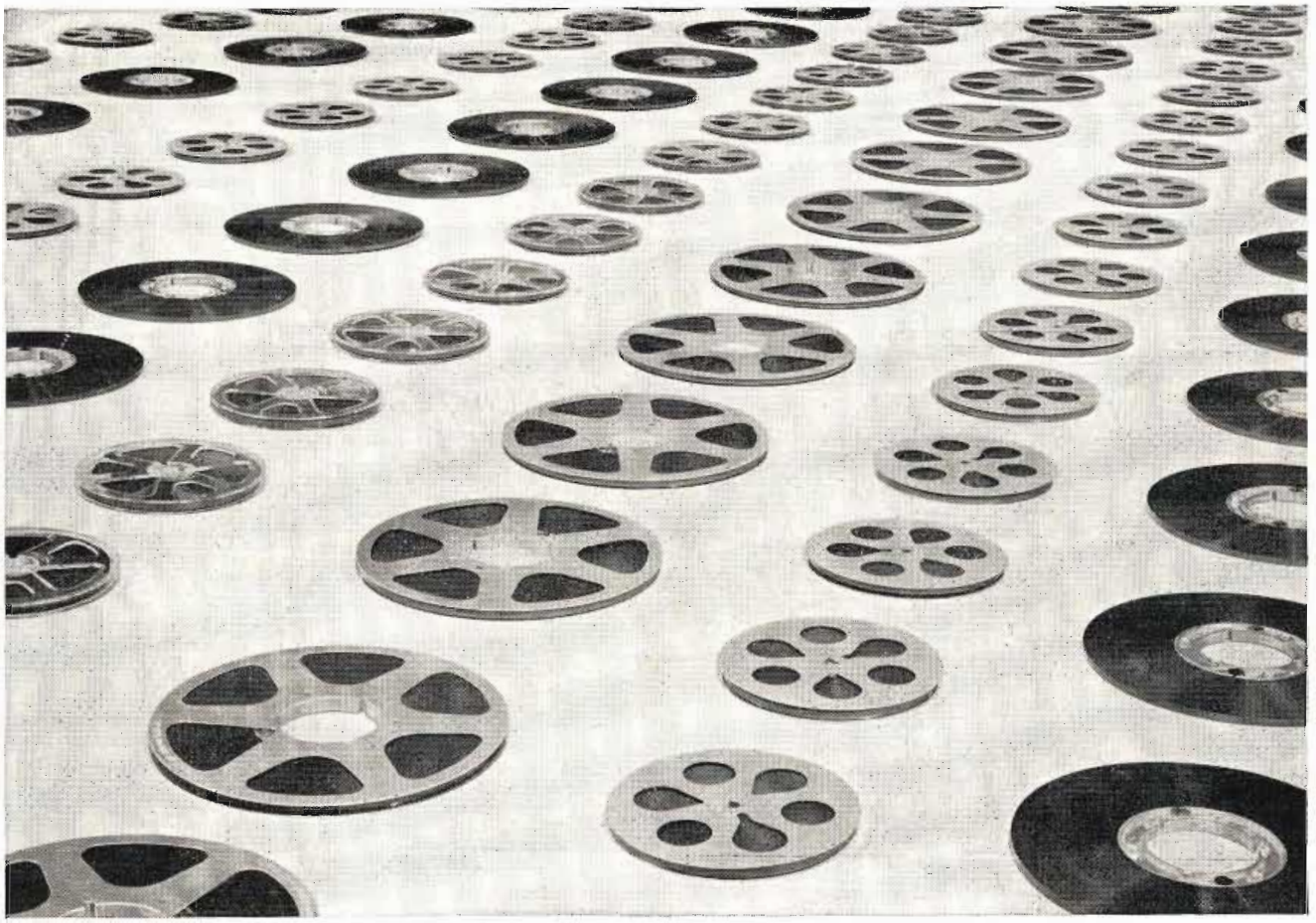
MARSHALL PLAN STEEL certainly travels a long way these days! One of our correspondents—a loudspeaker manufacturer—reports that a recent batch of steel which was bought from abroad still bore the original Marshall Plan stamps. Pittsburgh to Chicago via France is quite a detour!

PARAPLEGIC MFG. CO., 10068 Franklin Ave., Franklin Park, Chicago, is owned by 63 paraplegics, 52 of them in wheelchairs, and employs 90 persons in radio-electronic manufacturing and testing. President N. S. Josefson, electrical engineer, said that the company is negotiating for production of radar components, electronic controls, and various radio devices for military use.

"PROJECT TYPHOON" — Recently completed at RCA Laboratories, Princeton, N. J., is the largest and most accurate electronic analogue computer ever built to evaluate the performance of guided missiles, airplanes, ships and submarines. Designated "Project Typhoon," the new computer is expected to save the Government many millions of dollars in the design of guided missiles and also solve many problems in the air protection of American cities. The instrument, developed under contract with the Office of Naval Research for use by the Navy Bureau of Aeronautics, eliminates trial-and-error tests in which costly materials are expended.

(*Continued on page* 20)

CONSISTENT UNIFORM QUALITY



. . . reel after reel after reel!

That's just one of the EXTRA VALUES that you get in **audiotape***

made by audio engineers, for audio engineers

NOW — output curves in every package!

Here's output uniformity that you can *see* for yourself. For every 5-reel package of plastic base Audiotape, in 1250 and 2500 ft sizes, now contains an Esterline-Angus output curve made from one of the reels in that package. And since all five reels are slit from the same roll after coating, it shows you the actual output characteristics of every reel — giving positive visual proof of unequalled uniformity.

● Yes — when you reach for a reel of Audiotape, you can be *sure* that you will have the finest recording that your equipment can produce. You *know* that the output volume will not vary more than ± ¼ db within every 1250 ft or 2500 ft reel of plastic base Audiotape. That is *guaranteed*. You *know* that these reels are entirely free from splices. That is guaranteed also. But, still more important, you know that you can depend on Audiotape for unequalled over-all performance — with maximum fidelity of reproduction and minimum surface noise and distortion.

In short, Audiotape *always* gives you the same consistent, uniform quality that has characterized Audiodiscs for more than a decade.

Have you heard about our new disc *recoating service?* We are now prepared to recoat your used discs for you — at a substantial saving over the cost of new discs. Your Audiodisc distributor will be glad to give you complete details.

**Trade Mark*

AUDIO DEVICES, Inc.

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Export Dept.: 13 East 40th St., New York 16, N. Y., Cables: "ARLAB"

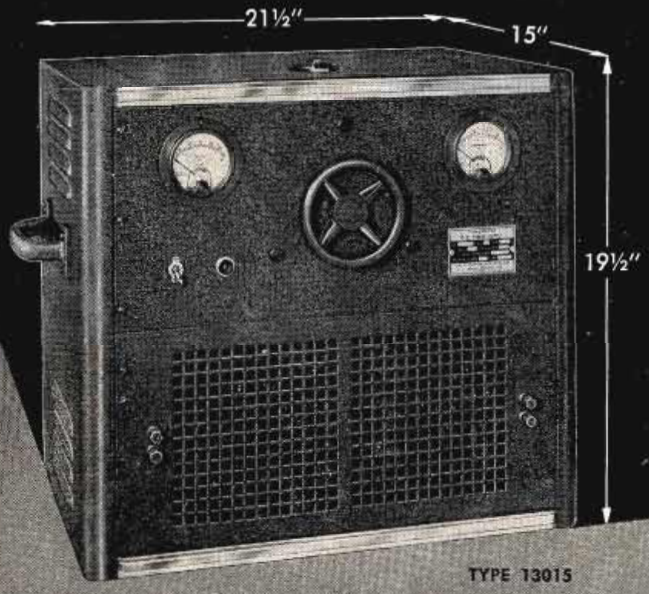
ENJOY MULTIPLE SAVINGS

IN TIME, SPACE and MONEY

WITH A

Varicell

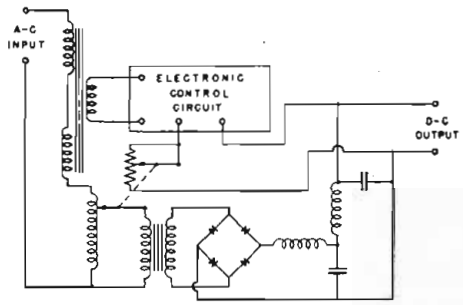
STABILIZED — REGULATED
VARIABLE D-C VOLTAGE
FROM AN A-C SOURCE



TYPE 13015

In keeping with rapid advancements of the electronic and nuclear fields, The Superior Electric Co. has developed the VARICELL D-C power supply. It provides a multiple range of regulated and stabilized low D-C voltages operating from an A-C source. You buy one compact unit — no need for several purchases, no need for accessories or special parts — to handle 6, 12 and 28 volts output. Control is centralized, space is conserved and engineers, technicians and test men welcome the convenient dependable performance.

VARICELL type 13015, illustrated above, is rated 95-135 volts, 60 cycles, 1 phase, A-C input; and 0-30 volts, 15 amperes D-C output. Stabilization and regulation is ±0.25 volts and R.M.S. ripple voltage never exceeds 0.1 volt for the output range of 6 to 30 volts. Any output voltage setting is not affected by line voltage changes or load current variations. For more detailed information fill in handy coupon and mail.



WRITE FOR VARICELL BULLETIN TODAY

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

MANUFACTURERS OF VOLTAGE CONTROL EQUIPMENT

- POWERSTAT VARIABLE TRANSFORMERS
- STABILINE VOLTAGE REGULATORS
- VOLTBOX A-C POWER SUPPLIES
- VARICELL D-C POWER SUPPLIES
- 5-WAY BINDING POSTS
- LIGHT DIMMING EQUIPMENT

-----THE SUPERIOR ELECTRIC CO.-----
1706 Church Street, Bristol, Connecticut

Please send me more information on_____
Please have a SECO Voltage Control Engineer call ☐

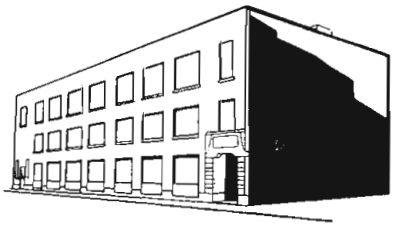
Name_____

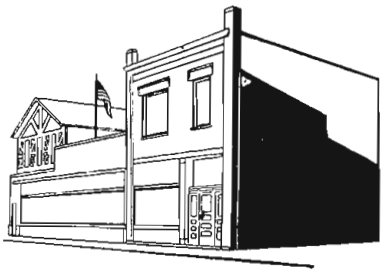
Company_____

Co. Address_____

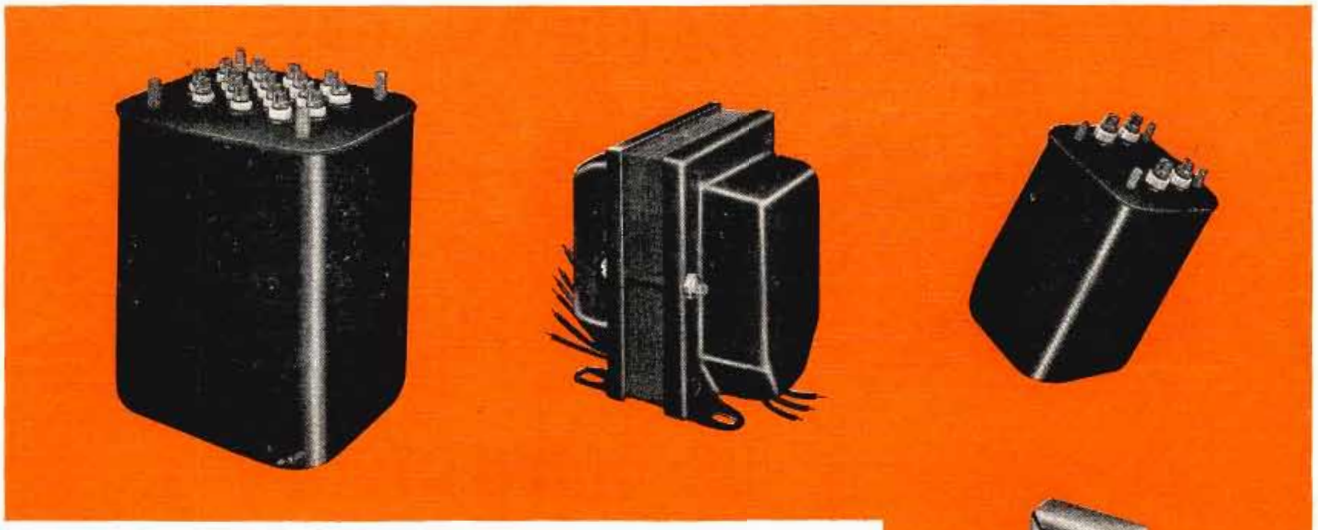
City_____ Zone___ State_____

3 *plants serving the* ELECTRONIC INDUSTRY





YOU GET THE BEST FROM MIDWEST



Each modern plant is staffed by experienced personnel employing the latest equipment and electronic knowledge to produce uniform components of consistent quality for television and radio.

Our engineering department is always ready to assist you with any problems. The long association of MID-WEST COIL & TRANSFORMER COMPANY and the electronic industry is your assurance of SERVICE, QUALITY and DEPENDABILITY.

MID-WEST COIL & TRANSFORMER COMPANY is qualified to produce to JAN-T-27 or MIL-T-27 government specifications.

WE INVITE PRIME and SUB-CONTRACT INQUIRIES.

TRADE MARK REG. U. S. PAT. OFF.

MID-WEST COIL & TRANSFORMER CO.

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BRANCH OFFICES

NEW YORK CITY
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Better Circuit Reliability

Without

OPERATOR ADJUSTMENT

Sync Generator set up with compact GPL Control Console

POWER SUPPLY Built in

the New GPL SYNCHRONIZING GENERATOR

SMALLER THAN EXISTING UNITS

EASY MAINTENANCE

BUILT-IN POWER SUPPLY

STANDARD RELAY PANELS

Easy to Rack Mount

The GPL Synchronizing Pulse Generator provides circuit reliability superior to that of comparable studio equipment. Operator adjustments are now eliminated by means of advanced circuit design, including binary counting circuits, delay-line-controlled pulse width – all operating from a stable master oscillator. The generator provides standard RTMA outputs with automatic termination of unused outputs. The AFC circuit is readily set to operate at mid-range when locked to the line.

Since the unit is smaller than existing equipment, even with its self-contained power supply, it is ideal for field operation. Swing-down panels simplify maintenance. Components are mounted on standard relay panels, facilitating studio rack mounting.

Typical of other GPL developments, the Synchronizing Generator is designed for maximum quality, operating efficiency, and dependability. Write for literature and operating information.

Write, Wire or Phone for Details

General Precision Laboratory

INCORPORATED

PLEASANTVILLE **NEW YORK**

TV Camera Chains • TV Film Chains • TV Field and Studio Equipment • Theatre TV Equipment

TELE-TIPS

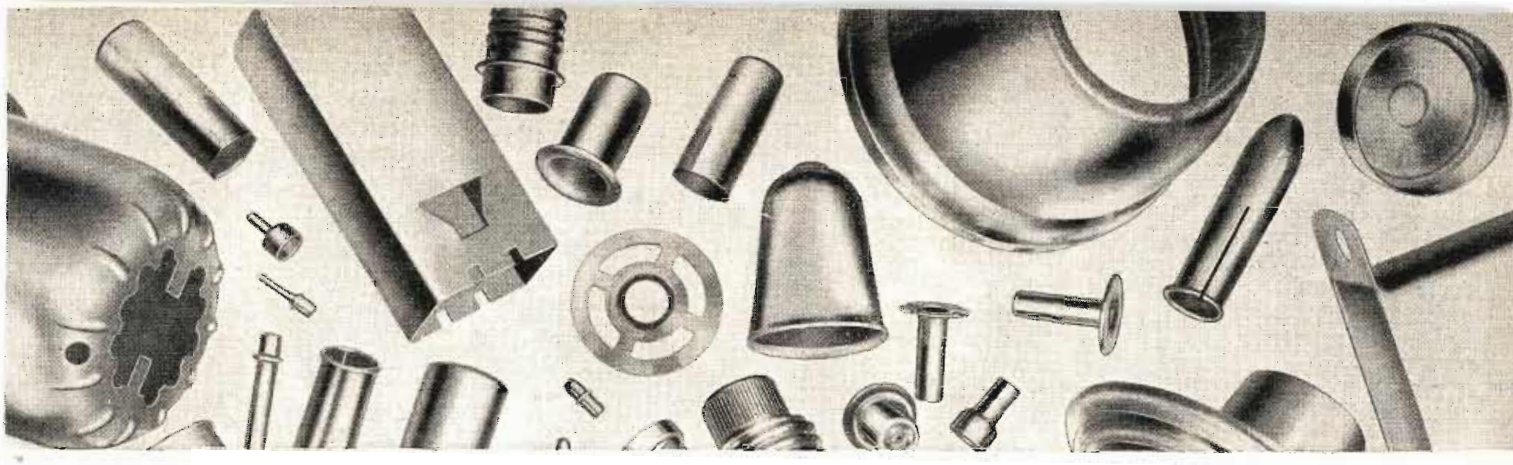
(*Continued from page* 14)

15,000 TIMES BRIGHTER!—In the past, projection television has failed to win public acceptance using projection tubes only 50 times as bright as direct-view tubes. "It now seems entirely feasible to build a receiver tube six in. long and less than an inch in diameter, which will have a screen brightness 15,000 times that of today's direct-view tube," declares Philo T. Farnsworth. "With such a tube we shall be able to use a built-in screen in the receiver or to adjust the set so that an image may be projected in three-by-four-foot size on a separate screen or wall."

TV-ANTENNA SWAY—In connection with the new Empire State Building multi-station TV antenna, it is interesting to note that in the gale which buffeted New York last Fall there was sufficient movement in the building to crack plaster out of the ceiling in offices in the upper middle portion of the building. A tenant who was in the building on the day of the gale said his office moved sufficiently to give the feeling of a ship at sea. He also showed us holes in his ceiling where plaster had fallen. While this is an indication of the safety "give" factor of the building, it also makes one shudder at the thought of being up there with the TV men near the top of the tower in a similar gale!

A STEAM-SHOVEL'S mis-stroke recently cut off the program line to WJZ (ABC) at Lodi, N. J., but the network's FM station on the Empire State Building continued to transmit the same program. So station engineers picked up this transmission, fed it into the AM transmitter, and continued on the air. Only 5 minutes of air-time was lost! Here's a case where duplicate programming paid off!

DYES FOR IRON CORES—Dr. G. A. Altmann, research chief for G A & F Carbonyl Iron Powders, announces successful development of a group of dyestuffs that can be incorporated with the carbonyl iron powder in core production to identify various types of cores for special uses. They will eliminate the time-consuming marking of cores by engraving, embossing or paint, and will reduce the hazard of errors in core selection. The new core dyes are stable under humidity, temperature and wide range of molding pressures. They show their colors in all shapes and over long periods of time.



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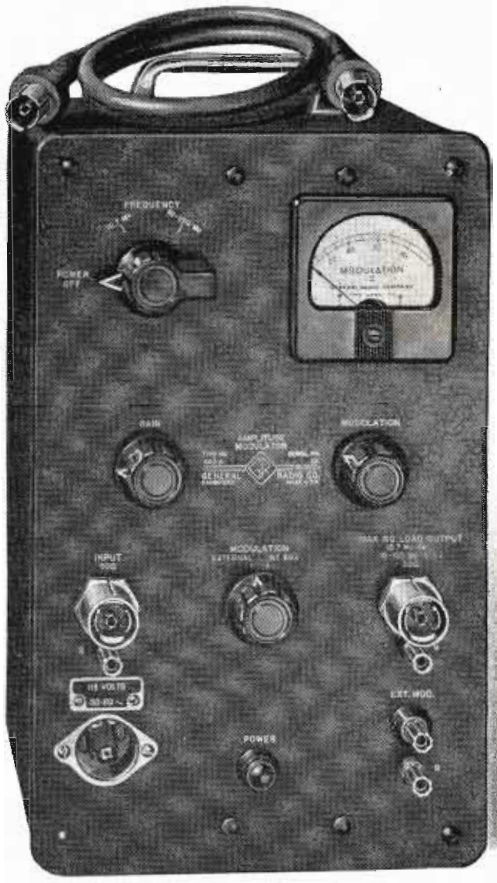

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It is particularly useful for checking the performance of such apparatus as voice ground-to-air communication equipment; air navigation Omnirange and ILS; telemetering and remote control equipment using AM.

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One of its features is a second range of 10.1 to 11.3 Mc. At 10.7 (the RMA standard F-M receiver intermediate frequency) this range provides a gain of 10 with a band-width to the half-points of ±0.6 Mc, gain and modulation percentage being substantially independent of input voltage at levels up to 0.1 volt. Output voltages up to 3 volts can be obtained without serious increase in envelope distortion, with some change in gain.

Modulation up to 80% is provided, either internal at power-line frequency or external from 20 to15,000 cycles. Envelope distortion is less than 5% at 80% modulation. From 1 microvolt to 1.5 volts gain and modulation percentage are practically independent of r-f input voltage.

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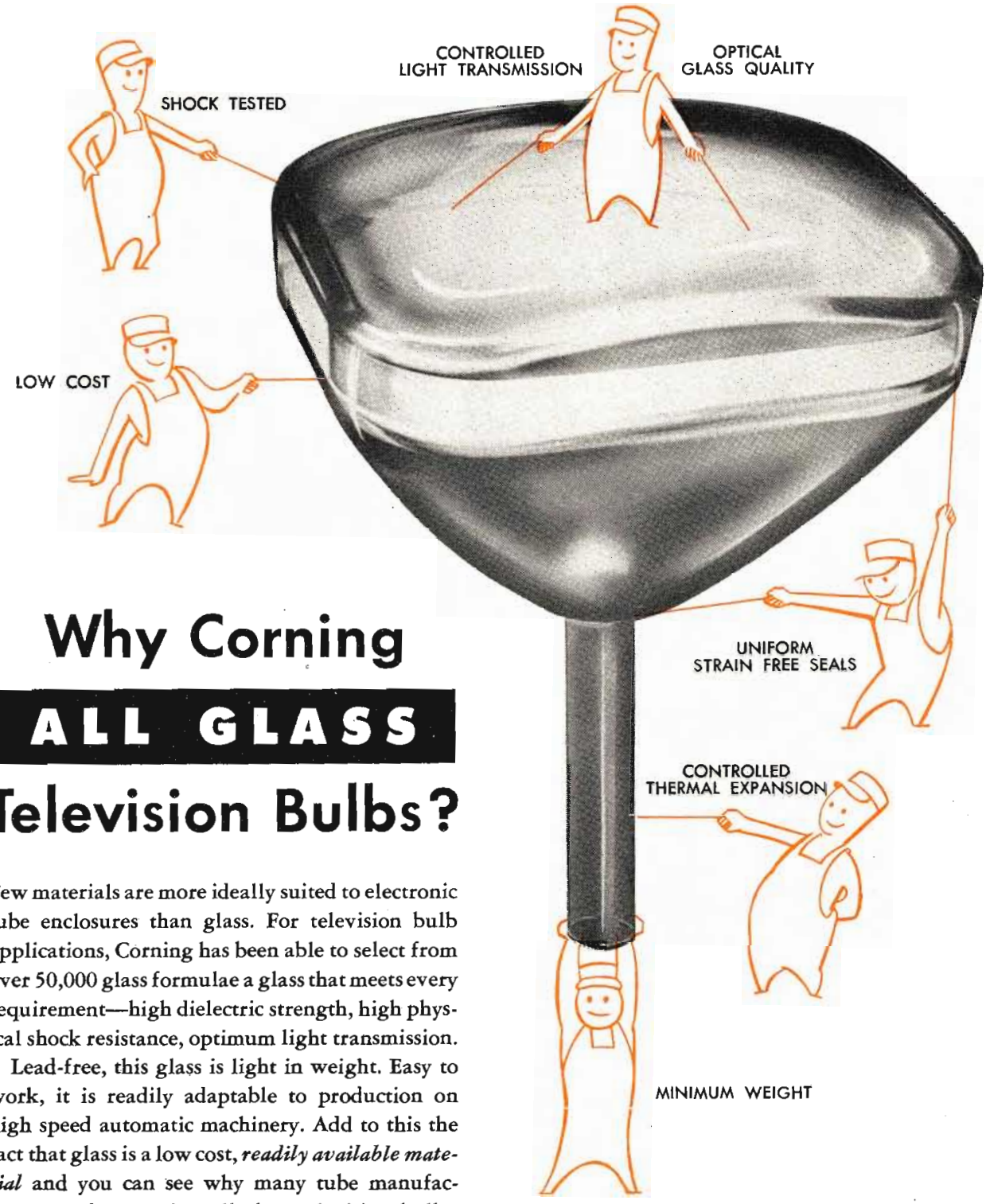

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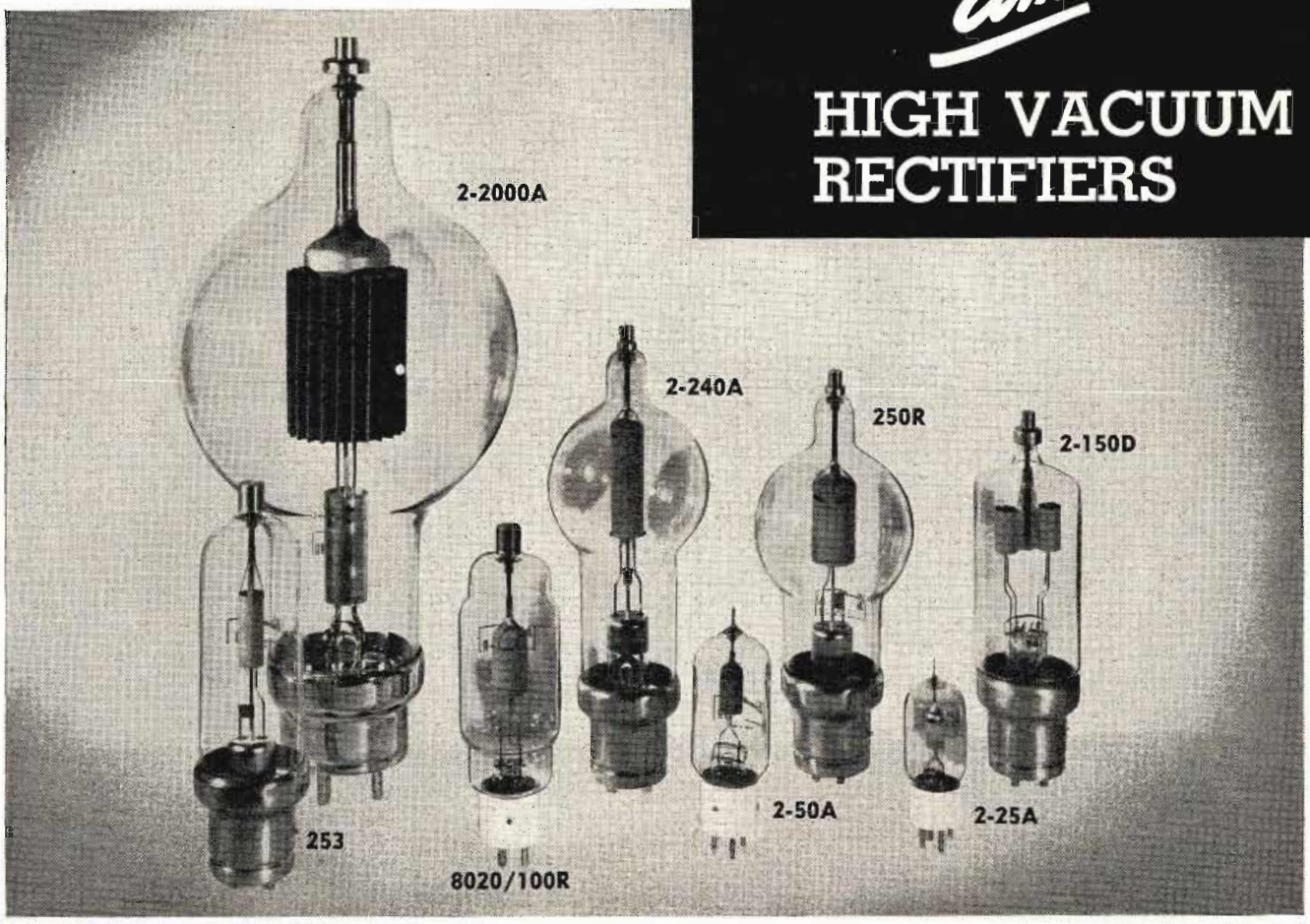

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TYPE	DESCRIPTION	MAXIMUM DIMENSIONS Length Inches	MAXIMUM DIMENSIONS Diameter Inches	AVERAGE PLATE CUR. Ma.	PLATE DISSIPATION Watts	PEAK INVERSE VOLTAGE Volts	FILAMENT Volts	FILAMENT Amps.
2-25A	High vacuum rectifier. High voltage, medium current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	4.5	1.5	50	15	25,000	6.3	3.0
2-50A	High vacuum rectifier. High voltage, medium current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	5.75	2	75	30	30,000	5.0	4.0
2-150D	High vacuum rectifier. High voltage medium current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	8.88	2.75	150	90	30,000	5.0	13.0
2-240A	High vacuum rectifier. High voltage, high current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	11.25	4	500	150	40,000	7.5	12.0
2-2000A	High vacuum rectifier. High voltage, high current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	18	8.25	750	1,200	75,000	10.0	25.0
250R	High vacuum rectifier. High voltage, medium current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	10.25	4	250	150	60,000	5.0	10.5
253	High vacuum rectifier. High current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	9	2.75	350	100	15,000	5.0	10.0
8020/100R	High vacuum rectifier. High voltage, medium current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	8	2.38	100	60	40,000	5.0	6.5

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TELE-TECH

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O. H. CALDWELL, Editorial Director ★ M. CLEMENTS, Publisher ★ 480 Lexington Ave., New York (17) N. Y.

More Defense Contracts for Small Radio-Electronic Manufacturers

Small manufacturers, comprising the bulk of the Radio-electronic industry, are coming into their share of defense contracts. This is the result of efforts from Department of Defense level to spread military procurement among more prime contractors as well as to encourage a greater degree of subcontracting.

Procurement Directives Coming

It can be reported by TELE-TECH on top authority that considerable attention is being given to this problem and that wheels are already in motion to issue additional directives to military procurement agencies—directives which will assure further spread of defense contracts to Small Business. Consideration is also being given to methods for policing procurement actions to insure conformance to top-level procurement directives by contracting officers.

Negotiated Contract Information

In still further efforts to spread military contracts, high-level planners are proposing to establish procedures to extend the weekly reports on invitations for bids to include advance information on proposed negotiated procurement in addition to the information now being furnished on advertised procurement through the Department of Commerce. From these synopses, radio manufacturers will be informed of proposed procurement in which they may wish to participate as prime contractors for negotiated contracts, and also may learn of the successful prime contractors from whom they may wish to seek subcontracts.

The importance of published negotiated procurement information is emphasized by the fact that during March, 1951, $44,025,900 in contracts was negotiated by Signal Corps while only $3,490,800 was by advertised bid.

Small-Business Share Revealed

In terms of percentages, 40.9 percent of the dollar value and 73.3 percent of all contract actions by the Signal Corps during March, 1951, went to small business, employing fewer than 500 persons, while the remainder went to larger firms.

The Department of Defense is accumulating considerable evidence that top-level efforts to spread defense business is bearing fruit. Every indication is that this trend will continue and spread during the 1951-1952 peak procurement period.

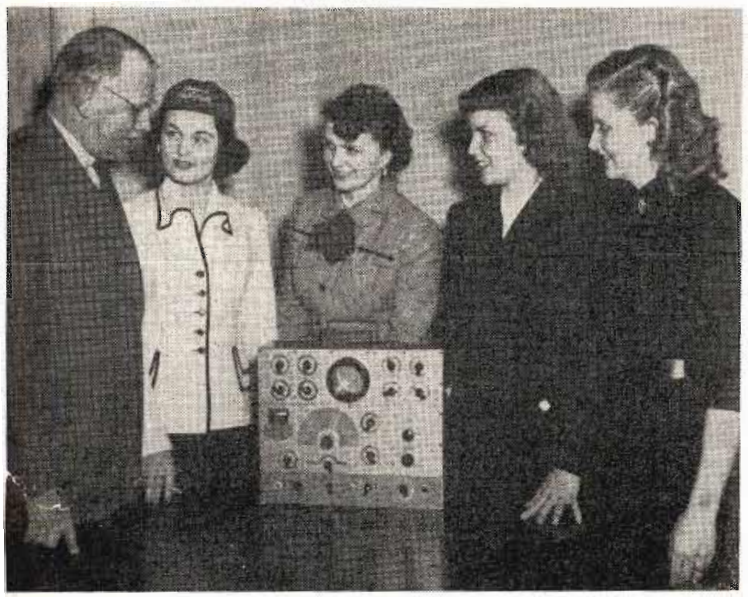
The RADARSCOPE Revealing at a Glance

REARMAMENT

CAN KEEP UP HALF OF NORMAL PRODUCTION—If strategic short-supply metals and materials are available, the electronic-radio-television manufacturing industry should be able to continue the production of civilian broadcasting-television-mobile radio equipment at approximately one-half of the normal rate as has been achieved during the postwar years prior to the present mobilization emergency. This was an analysis by TELE-TECH secured from authoritative sources in Washington after the approval by the House of the third supplemental appropriations bill for the Armed services for the current (1951) fiscal year, and the Department of Defense budget for the next (1952) fiscal year starting July 1, 1951.

THE PENTAGON

FOR PROCUREMENT of communications and radio-electronic equipment, the two above funds' measures carry a total of $2,969,440,000 and this amounts to about one-half of the radio-electronic industry's aggregate production capacity. In the third supplemental appropriations for the current fiscal period, the Navy got the lion's share with $203.3 million for new equipment and parts for maintenance and repair, and the Signal Corps received $25.5 million for new procurement but obtained $123 million for price increases in connection with outstanding equipment contracts. President Truman in his 1952 fiscal year Defense Department budget recommended $1,740,840,000 for electronic and communications or nearly 6% out of the total procurement program of $29,743,381,000.



Leslie Woods, Philco engineering VP, and some of his 30 Radarettes from Temple University's classes in radio

EXCISE TAX

TV TAX 15% to 18%?—Outlook at TELE-TECH's press deadline was that the Congressional tax legislation framers now definitely favored recognition of television's tremendous value to the nation and the American public. This means that they will probably reject any huge increase from the present 10% Federal excise tax on video sets, and deny the Treasury Department its proposal of a 25 per cent levy—such tax to be imposed on the factory selling price. Compromise tax rate slated by House Ways and Means Committee during final consideration of new tax measure is expected to be between 15 and 18 per cent for the television excise levy. Undoubtedly power of television such as the "close to home" audience-enthralling demonstrations of the Senate Crime Investigation, conducted by Kefauver committee, and General MacArthur's address before Congress, brought home forcibly to the House tax legislation committee the fact that television is NOT a luxury as has been stressed time and again by TELE-TECH and its sister publication, *Radio & Television Retailing*.

UHF-TV

RECENT OBSERVATIONS and discussions tend to indicate that UHF-TV coverage may be better than expected—*provided* that due respect is paid to its natural shortcomings. The results of the Bridgeport UHF-TV tests seem to show that in many cases in *this particular area* reception on 500 MC. is better than that on VHF (Channel 4) transmitted from the same site and antenna height for comparison purposes. It certainly proves that interference is only noticeable by its absence. The many plans for UHF tubes and transmitters announced and shown at the recent NARTB Convention at Chicago, auger well for UHF's future if other things remain equal.

PATENTS

REVITALIZE U. S. SYSTEM—A militant campaign to enroll the nation's independent inventors, small manufacturers, and patent owners in a joint effort to "revitalize our patent system and prevent its further destruction" has been launched by the Patent Equity Association, Inc., 545 Fifth Avenue, New York. Declaring that the court records show the "patent system is breaking down, if it has not already broken down, the directors urged: 1. Legislation to create patent courts manned by judges educated not only in law, but also in electricity, or mechanics, or chemistry. 2. Creation of a single court of patent appeals to be manned by judges who believe in the principles of our patent system and who are selected for their legal and scientific training and ability. 3. Opening of govern-

ment-owned patents to all citizens, except where curtailed for security reasons. 4. Extension of the life of war-curtailed patents for a period equal to that during which the government prohibited their manufacture. 5. Opposition to the compulsory licensing of patents. John V. L. Hogan and Austin G. Cooley are among the radio men on the board.

AUDIO

MAGNETIC TAPE as a preferred medium continues to make inroads in the audio recording field. Design attention is now being focused on the development of smaller, lighter, and self-powered portable equipments for remote pickup purposes. Aside from the obvious applications in the broadcasting field, increased availability of these "On-the-Spot" units will open many new markets. For example, the FBI and local law enforcement agencies can use such units to replace pads and pencils during interviews. Insurance investigators will be able to provide the home office with complete first-hand reports. Journalists will find them invaluable for interviews and combat correspondents can make eye-witness recordings describing the progress of battle. Equipments now marketed are about the size of a shoebox, weigh under 15 lbs., and use batteries as a source of power for both the recording amplifier and tape-drive motor. Last month TELE-TECH (p. 76) reported a new design employing a spring-wound constant-torque motor, which by eliminating motor battery drain, permits a still further reduction of both size and weight. Further details and a photograph of this unit appear in this issue.

MATERIALS SAVING

SHORTER LEAD LENGTHS in new equipment will definitely save a considerable amount of copper. In order to save cost of tools and machinery and extensive changes at the resistor factory and to provide for the purchase of either long or short lead resistors, the resistor leads can be cut to size after manufacture at the resistor factory. This seems to be a practical solution to the shorter resistor lead if some arrangement can be made whereby the credit can be given the resistor company for the reclaimed copper from clipped resistor leads.

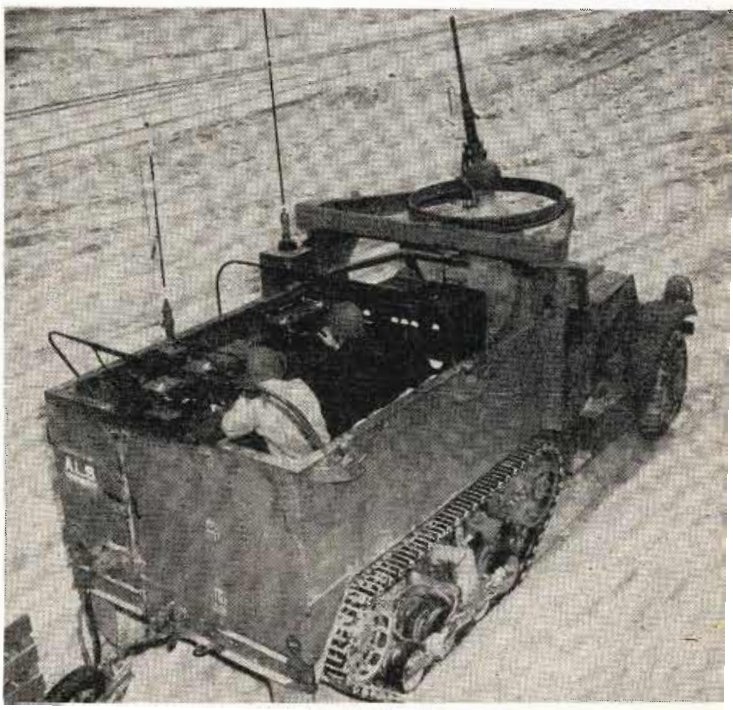
The use of copper-clad steel for several applications was discussed by the RTMA Material Bureau Council. It was found that an expanded use of copper-clad steel for military telephone wire will probably make copper-clad steel a shortage item, so that its use as a substitute for copper wire is not advisable at this time. Also the performance of copper-clad steel for hermetic seals and because of rusting is not considered satisfactory.

MINIATURIZATION

TWO-OUNCE AMPLIFIER—What the television set of the future may be like, is predicted by E. L. Crosby, Jr., of Bendix Radio, Baltimore, who contrasts two direct-coupled high-frequency amplifiers which have almost identical functions in a receiver. One, however, is 18 inches long, contains 204 precisely-made parts and weighs twenty-nine ounces—nearly two pounds. The second—its near-twin in operation—has only thirty-five parts, weighs less than two ounces and can be almost concealed in the palm of one hand. Applied to TV, this tiny amplifier provokes the thought that tomorrow's home electronic entertainer may be largely cathode-ray tube and little else inside the housing cabinet, if sub-miniaturization is carried to its ultimate end.

BROADCASTING

ELIMINATION OF OPERATORS in radio stations may not be far off if present progress continues. Recently developed and demonstrated equipment indicates that the average broadcast station transmitter can be made entirely self-operated provided it is properly installed and regularly inspected. This is one way in which broadcasters can beat the ever growing demands of workers for more and more money. Automatic television transmitting equipment is more difficult to design since human judgment "on the spot" is also required in evaluating pictorial quality.



Interior SCR-299 on half-track mount used in Air Liaison Communication. Note 60-caliber machine gun for antiaircraft protection.

New Vacuum

Comparison of terratex scription of the latest

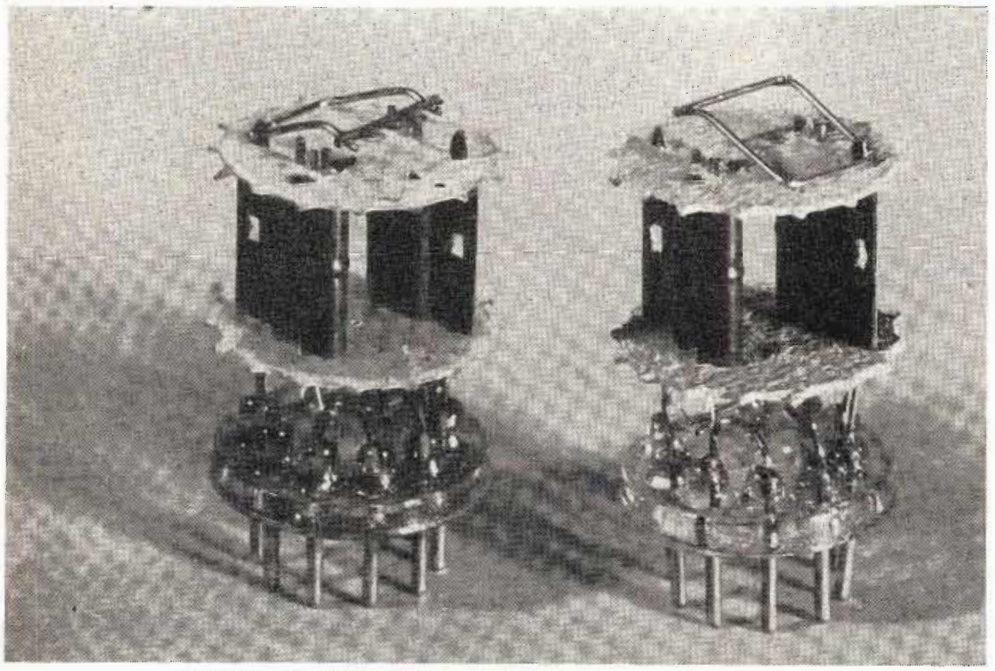


Fig. 1: Receiving type vacuum tube structure at left uses conventional mica insulating spacers. Structure at right employs new material known as terratex

By A. P. HAASE, and E. B. FEHR,

Special Development Sec., General Electric Co., Owensboro, Ky.
Tube Div. Headquarters, General Electric Co., Schenectady 5, N. Y.

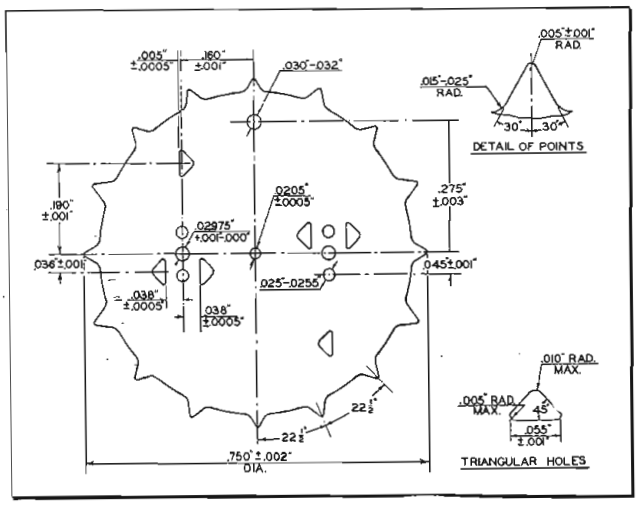
IT is the objective of this paper to report the progress made on two long-range projects of material substitution conducted within the General Electric Company. We should like to emphasize that although successful application of these materials has been obtained considerable work is yet to be done. It is hoped that this paper will stimulate further research and development and will encourage applications of the spacer and anode materials to be described.

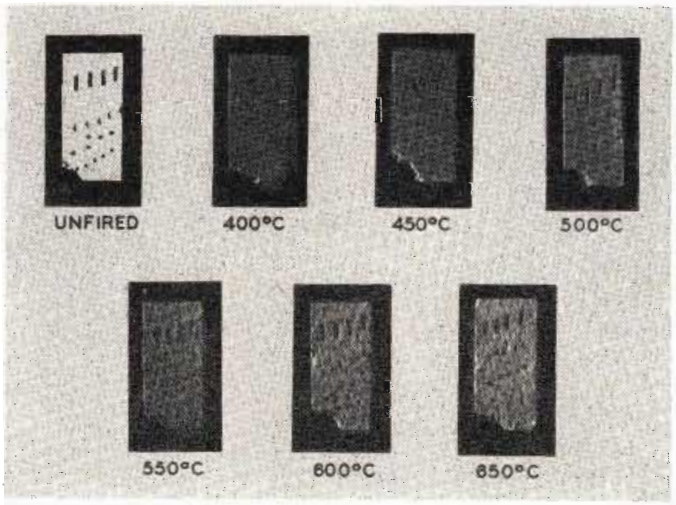
For a number of years considerable activity has been devoted to the development of a satisfactory mica substitute. While the progress made in this field certainly has been significant, an easily producible material satisfactory for vacuum tube applications has not yet been reported.

Development of Terratex

In a paper presented to the AIEE in 1948, T. R. Walters, of G-E Works Laboratory at Pittsfield, reported the original development of a material known as terratex. The material which we use is a special form of this terratex and is designated as type 2660B. Although the untreated paper-like sheet of terratex is mechanically weak, a process has been developed to give it desirable physical characteristics. In order to make it suitable for use in vacuum tubes, the spacer material is impregnated with partially hydrolyzed ethyl silicate which, when dried, yields the tough terratex which we use for spacers. We have found that care must be taken in the choice of hydrolyzing acids used when forming silicate-treated terratex for vacuum tube use so that contaminants are not introduced which would be harmful in the tube. Although the processing of the spacer material is not yet complete at this stage in the manufacturing process, the terratex in this

Fig. 2: (Left) Spacer diagram showing dimensions and tolerances typical of miniature vacuum tube applications. Fig. 3: (Right) Chart showing punching characteristics of terratex, air fired at the temperatures indicated for a period of five minutes





Tube Materials

PART ONE OF TWO PARTS

as a substitute material for mica spacers in vacuum tubes and a development in aluminum-clad iron materials as a replacement for nickel

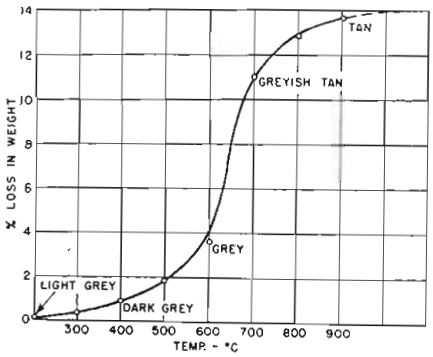


Fig. 4: Effect of temperature on terratex

condition can be stored or shipped conveniently without noticeable deterioration.

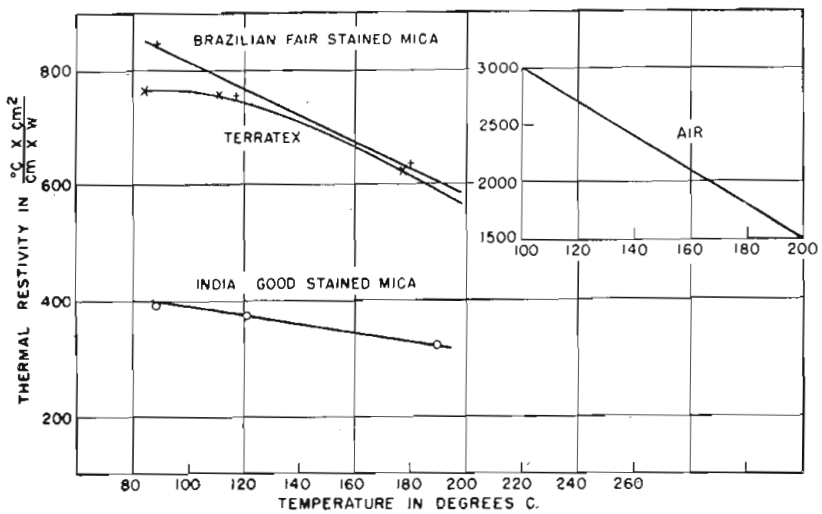
Before proceeding to the additional processing required, let us briefly examine the requirements of spacers. Fig. 2 shows a typical vacuum tube spacer and includes some dimensions with their tolerances, which are typical of miniature vacuum tube applications. It can be seen that there is very little room for variations in the hole size or shape if the tolerances are to be met. In order to assure reasonable uniformity of spacers, the material should punch cleanly and easily and should not flake or split when handled. In addition, it should retain a certain amount of resiliency in order for the spacer points which contact the bulb to yield slightly as the mount is inserted in a bulb which is slightly out of round or undersize. Chemically, the material should be stable so that storage problems are minimized and so that uniformity can be achieved from one tube production lot to another. Electrically, the material should have high resistivity and a low dielectric constant. In addition, for vacuum tube applications considerable surface roughness is desirable in order to minimize the development of leakage paths during the operating life of the tube.

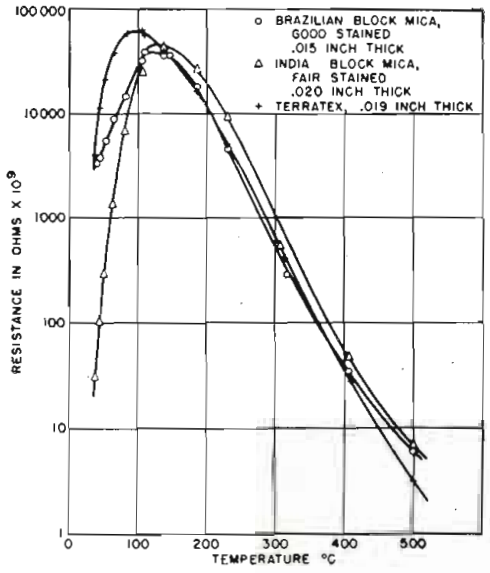
Heat-Treating of Material

The next step in the processing is one of heat-treating the material. Fig. 3 shows the effects of temperature on terratex and demonstrates the loss of weight as the terratex is heated. Most of this loss is due to the dehydration of the material, which results in a physical change yielding many of the properties discussed. Fig. 4 shows the effect on the material of air firing at various temperatures. The specimen in the upper left-hand corner is untreated except for ethyl-silicate impregnation, and its hole edges are quite rough and fuzzy. The lower left-hand corner of the specimen has been bent 90° and then pulled away from the specimen to indicate very roughly the characteristics of the piece as regards its brittleness and texture. The other specimens have been treated for a period of 5 minutes at the temperatures indicated below each piece. It can be seen that there is a slight improvement in punching characteristics as the temperature increases to approximately 500°C. This is due to an increase in surface hardness with increasing temperature. The 550°C specimen is relatively free of asbestos fibres, and the corner has broken away from the specimen rather cleanly. The 600°C specimen is very clean as far as hole punching is concerned, but the piece is quite brittle as can be seen from the characteristics of the broken lower left corner. This brittleness is, of course, undesirable and in actual practice is reduced by firing for a shorter period at a slightly lower temperature. From this it can be seen that by a very simple air-firing process it is possible to develop a material from the original impregnated sheet which can be punched cleanly and which retains sufficient resiliency to meet the requirements of the vacuum tube application. Following the heat treatment, the material is punched with an ordinary punch and die designed for mica fabrication and is then cleaned in water and methanol baths.

For vacuum tube applications,

Fig. 5. (Left) Thermal resistivities of mica and terratex Fig. 6: (Right) Comparison of insulation between mica and terratex





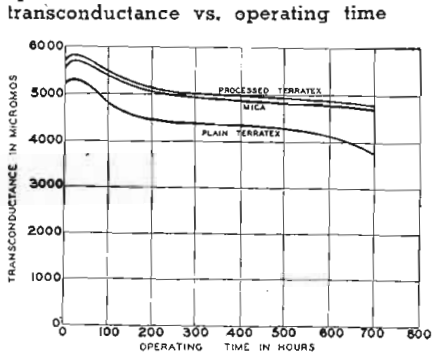
particular characteristics of the spacer material are of special significance. A comparison of the thermal resistivities of mica and terratex is shown in Fig. 5. It can be seen that terratex has approximately the same thermal resistivity as Brazilian fair-stained mica and is somewhat superior to Indian good-stained mica. The characteristics are, of course, difficult to measure accurately due to the variation in air spaces in the mica specimens. An interesting comparison of performance is that the cathode temperatures are about the same for tubes spaced with 20-mil terratex or 10-mil mica.

Effect of Temperature

The effect of temperature upon the insulation resistance of mica and terratex is shown in Fig. 5. This resistance was measured at a room temperature of 26.5°C and a relative humidity of 15%, between two tapered pins spaced ¼ in. apart. While these curves can hardly be considered to represent surface or volume effects, we believe that relative values can be assigned to the various materials as applied in high vacuum tubes. In general, these charactristics are essentially the same over the normal temperature range for the mica and terratex specimens. Measurements have been made of power factor and dielectric constant to 50 MC. At this frequency the power factor of mica and terratex are about the same, and the dielectric constant is approximately 3.5 as compared to the mica constant of 4.5 for the specimens measured. Fig. 1 shows an application of this spacer material with a conventional tube structure on the left for comparison purposes.

Although the chemical, mechanical, and electrical aspects of the spacer material problem have been discussed, there are undoubtedly other materials which would make adequate spacers if only the factors mentioned were given consideration. However, those other materials which might meet the material objectives outlined have been found to be unsatisfactory when applied to vacuum tube use. Usually the failures could be classified as inability to withstand the temperatures involved, inability to be degassed, inability to withstand thermal or mechanical shock, or incompatibility of the spacer material and the oxide-coated cathode. The last item usually involves loss of emission from the cathode due to "poisoning" effects which result from the reaction or combination of elements of the spacer's composition and oxides on the cathode. Considering these additional aspects of the spacer problem, the silicate-treated terratex has been found to have generally satisfactory characteristics in a number of different tube types.

Fig. 7: Comparison of mica and terratex spaced tubes. The curves illustrate 12AT7 transconductance vs. operating time



Operating Time Comparison

Fig. 7 shows an operating time comparison between the transconductance of type 12AT7 tubes spaced with micas and the same type tubes, identically processed, spaced with processed and plain terratex spacers. It can be seen from these curves that the results are quite comparable and satisfactory. Those familiar with the characteristics of the type 12AT7 probably realize that this is a tube extremely susceptible to modifications of any type. Consequently, satisfactory experience with this tube represents a considerable achievement as far as utilization of this new spacer material is concerned. Another interesting result was obtained when a number of terratex-spaced and mica-spaced 6J5-GT tubes were tested on a vibration-life test. Fig. 8 shows the remarkable difference in the vibration output characteristics of the two lots of tubes. The tubes were vibrated sinusoidally at a frequency of 25 cps with an acceleration of 2½ g and were read daily for a total of vibration time of 400 hours. It can be seen that the terratex-spaced tubes had much lower vibration output than the mica-spaced tubes over the entire period of testing. Another particularly interesting characteristic of the material is the high surface roughness, which makes for good interelectrode insulation. Measurements of interelectrode leakage were made over a life-test period of 500 hours, and it was found that the terratex-spaced tubes were considerably superior to the mica-spaced tubes at all testing intervals.

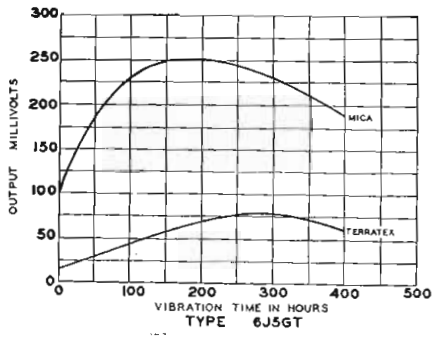


Fig. 8: Spaced tubes under vibration

From this brief discussion of the material, it is apparent that there are several advantages associated with the use of terratex. From the standpoint of supply and fabrication, it is possible to obtain strips or sheets of terratex of uniform thickness made from materials available in this country. Further, the material has high thermal and surface resistivities and exhibits certain physical properties which make it appear to be superior to mica in some cases.

Extent of Application

It is not known that terratex can be applied successfully as spacer material for all tube types, nor in its present development stage can it be used without decreasing exhaust machine production rates on certain tube types. However, upon the basis of the measurements which have been made on the material and upon the experience obtained in applying the processed terratex to vacuum tubes, it is likely that it could be applied to some types of tubes immediately and that its several advantages over conventional mica spacers could be realized without sacrificing production rates or tube quality. In order to evaluate the material more fully and to improve it, work is being continued on the project at the G-E Owensboro Development Laboratory. Terratex processed for use in vacuum tube application is not commercially available at this time. Considerable work on this project has been done by H. M. Broderick, of our Pittsfield, Massachusetts Plant, and L. U. Hamvas and W. C. Wicke, at Schenectady. C. W. Conklin and J. C. Hickle, of the Receiving Tube Division at Owensboro, Kentucky, have made outstanding contributions to the program.

(Part Two will appear in the July issue.)

The FCC Reports on

Television Intermodulation Tests

Important considerations involved in UHF-TV receiver design are compared with co-channel interference

THE FCC recently issued a revised report on the test made by the Laboratory Division under the direction of E. W. Chapin (of color TV convertor fame) on intermodulation effects on television receivers operating at 500 MC. Since this is a subject of particular importance to many engineers TELE-TECH is publishing the salient points of the report.

The problem of intermodulation interference is one which is gaining in importance with the increasing occupancy of the upper part of the frequency spectrum. Unfortunately there is a tendency to think in terms of a very large number of frequency channels which can be separated by receivers with suitable adjacent channel selectivity. However, the typical receiver attains its selectivity primarily in the intermediate frequency amplifier stages, whereas the selectivity at the signal frequency is only rudimentary. As a result, signals which are a number of channels away from the desired one can progress at least as far through the receiver as the first detector.

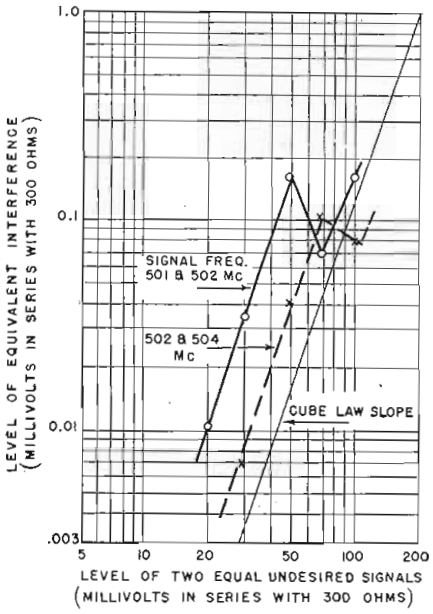
If two or more such signals find their way simultaneously to the first detector or any other nonlinear element in the early stages of the receiver, they may combine to produce an interfering signal which falls in the channel desired. This is known as the intermodulation interference effect. Whenever strong undesired signals are encountered any closer to the desired channel than 2 to 10 per cent of the frequency, the effect can be serious, depending on the degree of selectivity built into the receiver at the signal frequency.

On a 500-MC television channel, intermodulation interference may be a problem when the undesired signals are as far from the channel as 25 to 50 MC. At the 900-MC end of the proposed UHF band even wider parts of the spectrum may be affected.

The receiver which was the subject of these tests was a commercial television broadcast set with a channel switch which includes several UHF channels as well as the usual VHF channels. For these tests only the 500-MC channel was employed. Only one receiver was available for the test.

Two equal undesired unmodulated signals were simultaneously introduced at the input terminals of the receiver. The i-f signal in the receiver was fed to a Measurements Corp. model 58 noise and field intensity meter with a narrow bandwidth and meter indication which gave a satisfactory measurement of the levels of the i-f signals developed. The indication of this meter could be used as a reference to allow the determination of that *equivalent* signal on the desired channel which would produce the same effect as that of the spurious signal resulting from intermodulation of the two undesired signals. The signals were produced by Measurements Corp. model 84 signal generators which had been modified by the addition of biasing arrangements to disable the crystal rectifiers in the output measuring circuits, so that intermodulation could not take place in these crystals and be confused with that occurring in the receiver under test.

Fig. 1: Interfering signal as function of undesired signals, 1, 2, and 4 MC removed



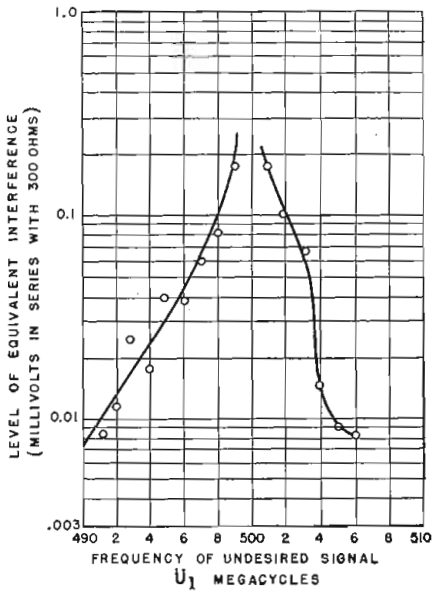


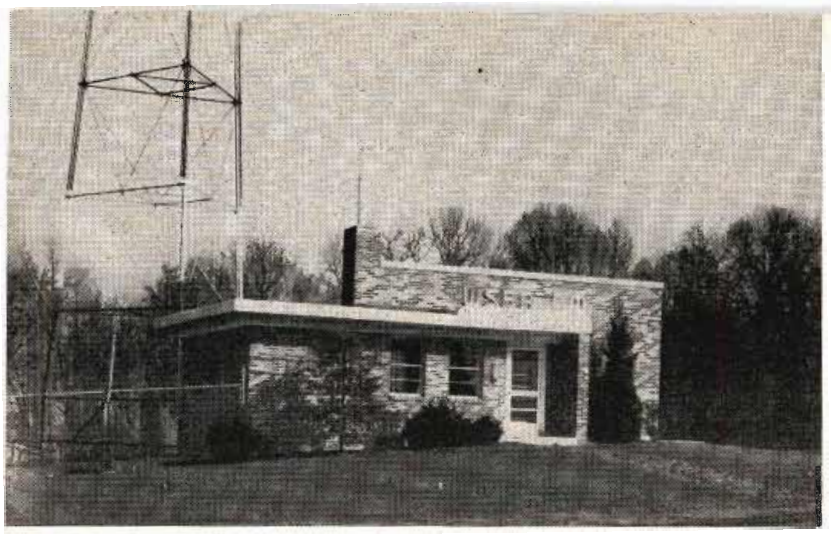
Fig. 2: Effect of frequency change in undesired signals receiver tuned to 500 MC

Fig. 1 shows the level of the equivalent interfering signal as a function of the levels of the two undesired signals, for the case of one undesired signal, 1 MC from the center of the channel, the other, 2 MC from the center, and also for 2 and 4 MC. It should be noted that the particular curves plotted are parallel to the cube law line over a part of their range of values.

The effect of the frequency of the undesired signals is plotted in Fig. 2. This curve was obtained for the conditions:

1—Equal signal levels of 100 millivolts were inserted in series with 300 ohms at the antenna terminals. The signals were fed into the receiver by means of a special connection block which provided for impedance matching and obviated the use of twin-lead or other connecting leads. The use of such connecting leads has usually resulted in measurements which are greatly affected by their length and position. Use of the connection block produces results which normally may be reproduced. Use of other connection methods which

(*Continued on page* 86)



WSBA, York, Pa. This building is a permanent advertisement for the station and is best located on an important and much used highway.

Broadcast

Survey of major points

By *QUINTEN G. CUMERALTO, Chief Engineer, WRZE, York, Pa.*

A typical mountaintop station. WRZE, York, Pa., is constructed along sound utilitarian lines without wasted effort on "dressing up" which not many people will be able to see. The STL antenna is visible on the antenna tower

PRE-CONSTRUCTION planning is the most important phase of constructing a new radio station and a mistake at this point can be very expensive. It is wise to contract for the services of experts, such as an architect, lawyer, and consulting engineer before going too far in planning. In most cases, proceeding without the services of these experts is false economy.

After the general plans are laid, such as power class, overall cost, etc., the selection of a transmitter site becomes the main problem. The final selection should be made by the consulting engineer, but it will be the management's responsibility to narrow the available sites down to two or three, after which the consultant will select the one best suited for the station. Unfortunately in many cases there will not be a choice.

Before the selection of the transmitter site can begin, it is advisable to decide whether to combine the transmitter and studio location. Each has advantages and disadvantages and the answer will depend upon the power of the station, the amount of money on hand, and the people involved. If operating costs are a factor, a combined location is recommended. Generally speaking, operating expense will be doubled when using separate studio and transmitters. In most stations it is important to have the studios within walking distance of the center of town, for the convenience of guest speakers, performers, and personnel employed by the station. It is interesting to note that in a survey taken some time back, combined studio-transmitters were used in about fifty percent of the stations in the 250 watt class, with separate locations becoming more popular as power rating increased.

In either case, before purchasing the land, the following must be considered very carefully.

Zoning restrictions. Check with the local authorities.

Accessibility and roadways. A good road, ploughed free of snow in winter, is important. Many a transmitter engineer has walked to work because the roads were not ploughed or the bottom fell out of the road in the spring!

Power. Will it be available at a reasonable cost? Three phase power is necessary in most cases. Emergency power line from a separate source is desirable. Dependability and regulation is important.

Program lines. Will the telephone company install high quality lines to the location?

Drainage and soil conditions. An efficient ground is important; and this efficiency should remain reasonably constant year around. Keep in mind the antenna foundation.

Water supply. Is fresh water available?

Sewage. City sewers? Septic tanks?

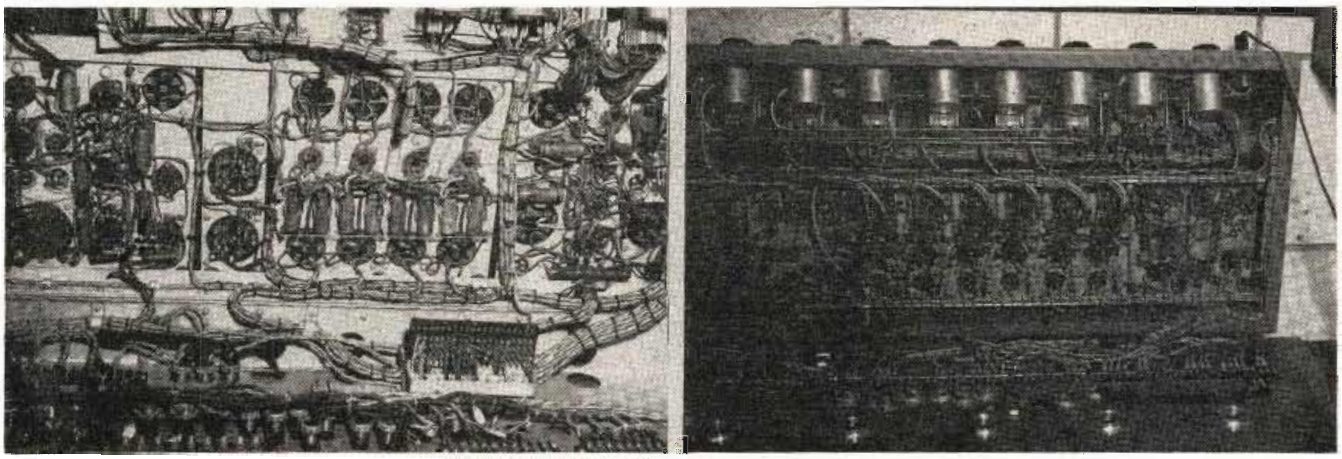
Tower restrictions. Check with the Civil Aeronautics Authority and the local government.

Coverage. It is important to provide adequate coverage over the studio location, not only in terms of micro-volts-per-meter, but in terms of the ratio to signal strength of other local stations over the same area. In many cases an apparently less desirable location will provide better local coverage in this respect.

Having selected the desired transmitter site, design of the buildings should be the next step. The important point to remember in building design is to build around the equipment. As a matter of fact, many of the manufacturers will supply plans and drawings for buildings designed around their equipment. This serv-

Station Construction Practices

which require experienced examination when designing or rebuilding a radio station



Typical installation wiring for an audio console (left) shows excessive amount of long leads, poor grounding and spare leads. The engineer who did this may expect hum troubles. In recommended method (right) of making connections to console, all shields are grounded to #14 wire which is tied to the chassis at many points. Conduit is brought close to the terminal points.

ice should be used whenever possible.

Equipment size will be almost completely dependent upon power. Transmitter sizes will range from single units for low power stations to multiple units for high power installations. Arrangement of the equipment will also be a factor when designing the buildings. There are six basic arrangements normally used; there are straight line, rectangular, semi-circular, offset panel, parallel, and "L" shaped. Personal preference will be the determining factor.

Flush mounting is attractive to look at but has the disadvantage of inaccessability and high cost of expansion. However, should flush mounting be used, a door or opening next to the transmitter saves many steps for the maintenance man. The cardinal rule in equipment arrangement is to keep all equipment within sight and reach of the control desk.

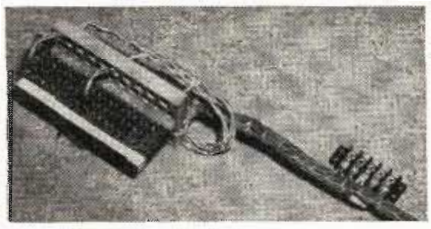
The external appearance of the transmitter building should be decided upon only after the transmitter site has been chosen. If the location is along a busy highway, a show place is in order to establish in the minds of listeners the character of the organization. On the other hand, a show place located in a remote area would be a poor investment. However, a well designed building is important no matter what the location.

Whatever the external appearance, there are minimum requirements for the internal planning. The first consideration is the transmitter room and control space, which should be designed around the equipment . . . with plans for future expansion. Phasing equipment, FM, or even TV may be necessary in the future. Such essentials as rest room, work shop, and plenty of storage space must be provided. Shower, cooking facilities and emergency studios should be considered. In remote locations, living quarters and garage are a good investment. These are essential considerations when laying out the transmitter building, although each building will present individual problems.

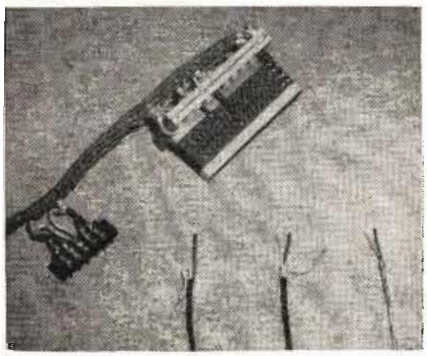
Noise Primary Factor

Noise is the primary factor in selecting the studio location. This noise may be airborne or "telegraphically" transmitted. Locations on a busy truck route, near an airport, near printing press installations or other similar high noise level sources should be avoided. It is a good emergency practice to check present tenants of the proposed building, as well as neighboring buildings, for sources of noise. It is well to be sure someone is not planning to add heavy equipment at some future date. First floor locations have the advantage of accessibility, but are more susceptible to traffic noises.

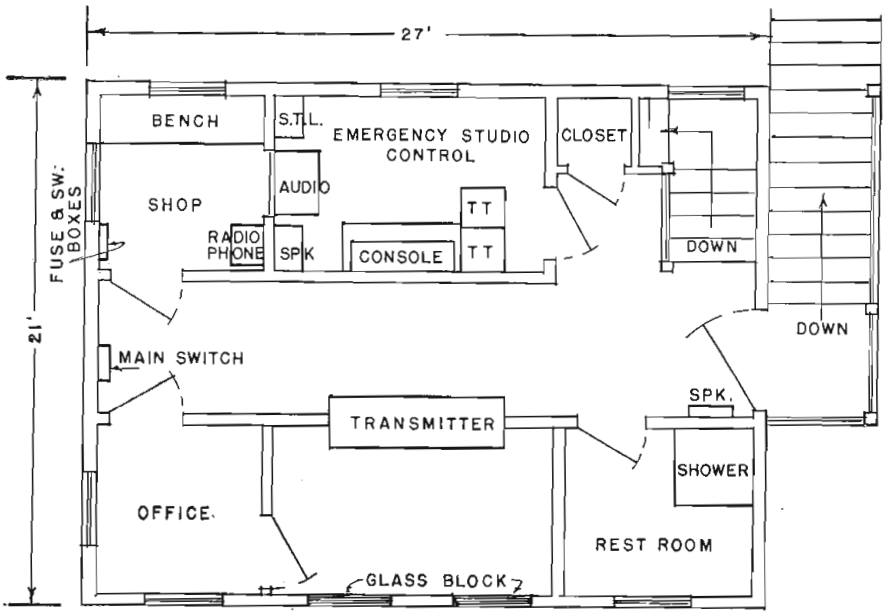
Basically, studios should be arranged in a semi-circular fashion around the control room, with unobstructed views into each studio. Raising the control room floors about three feet, with respect to the studio floors will increase the visibility and at the same time provide working space under the control room floor. Provision for combination work



This method of terminating pairs on popular WE 100B block is found in many stations



Alternative connections to WE 100B block, and method of finishing-off by pulling wires through shield to form ground leads



Floor plan of WRZE, second story. Note spaciousness and accessibility of areas

from the control room is advisable.

The actual design of the studio is best done by consultants who specialize in this type of work. However, many stations have *little use for a good studio* (editor's italics); particularly the small network station; or the additional cost for a well designed studio is prohibitive. If such is the case, the site will have to be chosen very carefully, as the degree of isolation is almost entirely dependent upon the location. In some locations, a modified room-within-a-room type of construction can be used to provide a reasonable amount of isolation, if the requirements are not too rigid. Many good articles on studio design are available and it is wise to consult them. The advantages of a sound lock or a small announce booth in addition to the regular studios should also be considered.

One source of noise is air conditioning, which should be installed in all studio areas. Isolation of all duct-work (by the use of canvas collars) from the studio blowers and air velocities high enough to supply load, and yet slow enough to keep noise level down, is important. The added load due to heat from the equipment should also not be overlooked.

If high quality transcription cutting is anticipated, a separate room with a floor having a low period of vibration should be provided, also adequate storage space for records and transcriptions.

Interconnecting cables may be run by one of four methods, or a combination thereof. (1) Exposed, without external guide or shield: This method should not normally be used. If absolutely necessary all pairs should be laced together, having regard to the various audio levels, to provide some degree of shielding.

(2) Conduit: This method provides the best shielding and isolation. However, plans must be made well in advance as it is difficult to add extra conduit after the initial installation. When this method is used it is wise to include extra pairs for future additions and modifications.

(3) Raceway or trench: The raceway or trench method is usually used in installation with concrete floors. The forms are laid before the floor is poured so that it is essential to provide for future expansion at the time of construction. Power circuits are run in conduit laid in the trench; while audio leads can be shielded through the use of lead covered cable.

(4) Ducts: Ducts similar to air conditioning and heating ducts may be used for running interconnecting cable. Metal barriers may be added to provide shielding between the audio circuits. These may be buried in concrete floors or run overhead in much the same manner as heating ducts. The tops or bottoms may have removable covers, depending upon which is accessible. It is a simple matter to change or add extra wiring when this method is employed.

Laying out of the interconnecting ducts, raceways, or conduit will require some forethought because it must be completed during the early stage of building construction. Changes or additions after completion of the building are expensive and time consuming.

All electrical wiring should be in conduit, installed to the standards set by the Underwriter's Laboratories. The only exception being the welding of all joints to improve the overall ground system.

Planning and layout of interconnecting conduit will be the chief engineer's responsibility. A plan should be drawn of all interconnecting conduit runs, showing the exact location of both ends of each conduit. For instance, all AC conduit for control room equipment should come up directly under the AC terminal block in the audio rack. And in the case of microphone and turntable wiring, all wallplugs should be from left to right to correspond to the console attenuator numbers. A copy of this plan should then be given the electrical contractor, who is installing the conduit. This will eliminate confusion during the installation. During this phase of the work a member of the engineering department should supervise the work. Without this supervision, he may deviate from the plan without realizing the consequences of such action.

Number of Conduits

Naturally, the number of conduits will depend upon the amount of equipment and the degree of isolation desired. Basically all low level circuits to any one point may be in the same conduit; the same is true of control and ac circuits. A number of high level circuits may be run in the same conduit if care is taken; although it is not advisable. Remote lines may be run in one conduit, but the program output leads should not be combined with other pair. However, it is permissible to run the spare line with the regular line. With regards to the console power supply, a minimum of three conduits is recommended. One each for filament, control, and high voltage circuits. In the case of combined studio transmitter installations additional conduit will be necessary for r-f monitor circuits, remote reading meters, remote switches, and ac power. This applies also to the duct method of running interconnecting cable, also. Multiple lead runs will be ducted console to rack, etc.; while two and three lead runs will be conduit.

(*Continued on page* 88)

KFAB's Magnecorder Modifications

Specific Requirements of Radio Station KFAB Call for Some Modification of Popular Magnecord PT6-JA Tape Recorder

By VINTON WIGHT,
Lincoln Studio Supervisor
KFAB, Omaha, Neb.

OPERATING engineers at KFAB have made several changes to their PT6-JA Magnecorder which increases its flexibility. Since a great number of stations use Magnecorders, this information appears to be worth passing along.

The first change was to remove Cannon plugs and replace them with Hubble twistlocks since Hubbles are used on all station equipment.

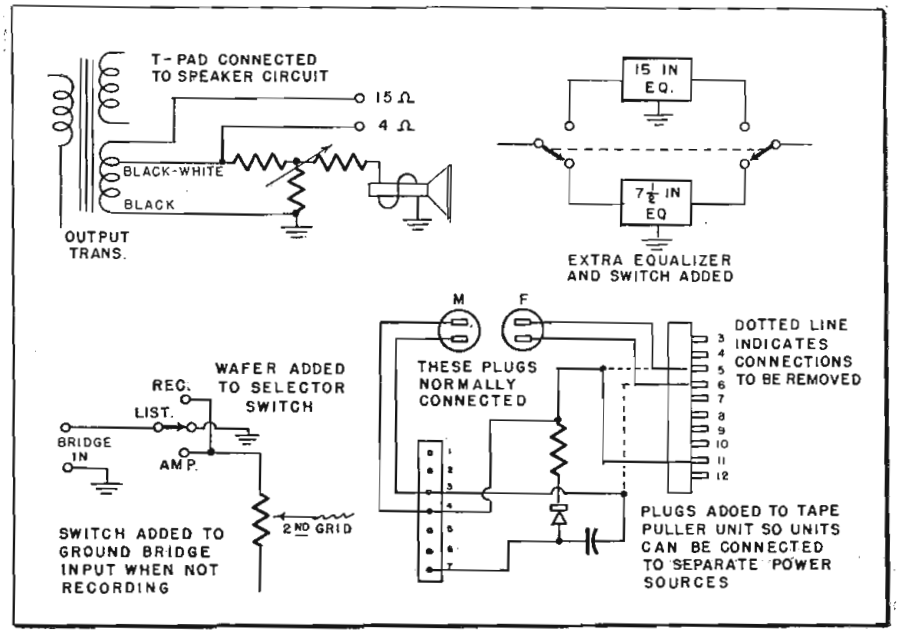
An independent control for the speaker volume is often desirable. Therefore a low impedance T-pad was connected in the speaker circuit. The speaker shut-off switch was removed. This makes the speaker volume independent from the amplifier control. Model PT63 amplifiers, however, are equipped with a speaker volume control.

The pilot light was removed and remounted in the hole left by the speaker switch. The T-pad was then mounted in place of the pilot light.

In order to eliminate changing the plug-in equalizers when changing the recording speed, KFAB modified the unit accordingly. To overcome this, an additional socket was installed on the chassis to accommodate the other equalizer. There is not a great amount of space available, but it can be done. A rotary switch was installed on the panel to select the desired equalizer.

Since the bridge input feeds into the second grid, there is no way to retard the speaker monitor with the selector switch when this input is used. This is because the selector switch operates on the input to the first stage, or the stage ahead of the bridge input. It has been learned that a double equalizer is available from Magnecord for this purpose, and is also standard equipment on PT63 and PT7 models.

But this is not the case when using the mike input because the selector switch cuts the mike in only when the switch is in either of the record, or the amplifier positions. In other words, if the mike input is used, the speaker monitor is available from the microphone only when the selector is in the record or the amplifier position. Because of this, the habit is formed of using the monitor as an indication of the machine's readiness for recording. This method of checking cannot be used when the bridge input is used.



Circuit changes are described in text. Most are self-explanatory

After losing some programs through relying on the speaker monitor, instead of the red indicator light, it was decided to make some changes in the circuit.

The selector switch was dismantled and an extra wafer added. This extra wafer was connected so that the bridge input was disconnected from the grid, and grounded, when in the listen position. (See diagram.) The added wafer must have a single pole three-position combination on the contacts.

Much of the recording is done in the field. This makes it necessary to supply a portable source of power. The station had available 75 watt 6 volt dc to 110 v. ac inverters. The recording amplifier unit draws 80 watts and the tape puller unit draws 90 watts. By splitting the ac input to the two units each can be used on a separate inverter. This makes recording possible on any 6 v. battery.

The tape puller unit normally obtains ac through the cable connecting the two units. The ac connector to this unit is changed as shown in the diagram. Both male and female ac connectors were added. The male connector is arranged so that an extension cord can be connected to it through one of the ventilating holes in the rear of the unit.

There is also a female connector which can be connected to the male connector for normal operation (as originally connected for operation from the regular power line). In other words when the recorder is used on the inverters, the normal power circuit to the tape puller unit is opened, and the main plug is connected to one inverter and the regular power cord (now connected to only the amplifier unit) is connected to the other inverter. When connected this way there is no fuse protection on the tape puller unit (other than the one on the primary side of the inverter) so it might be well to install one.

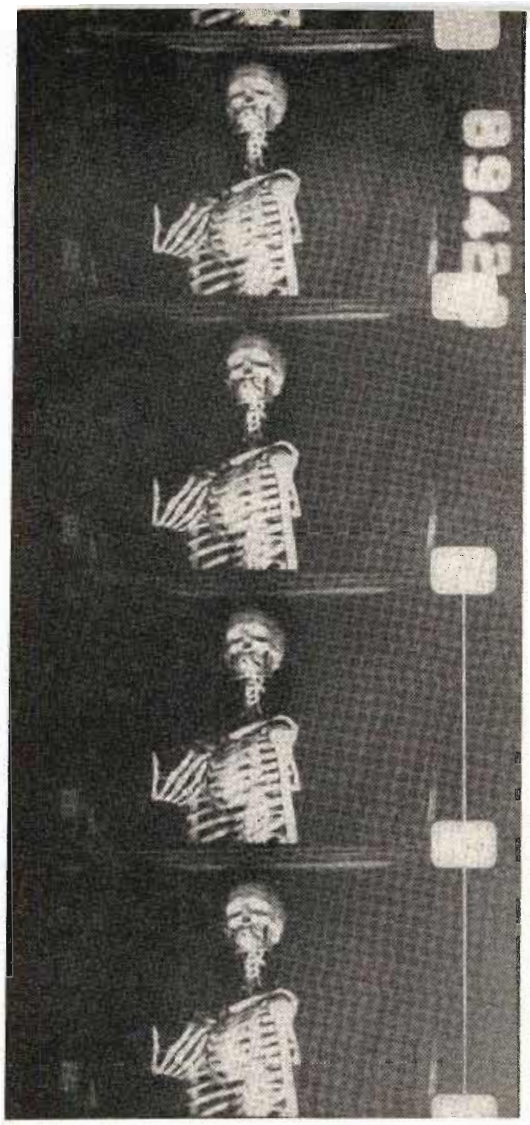


Fig. 1: Appearance of a strip of film taken in the slave camera under silent conditions. The white line on the perforation side is the index described in the text

Television Films

New method of filming appears using more than one camera and

By JOHN H. BATTISON
Associate Editor

(Presented at the Fifth Annual NARTB Broadcast Engineering Conference, Chicago, April 1951)

IN the production of films specifically for television, producers face the problem of meeting low budgets. This is also true for organizations which wish to produce films for internal or educational purposes. When Hollywood makes a picture, the money allocated is many times that which is available to the television producer for a similar film[1]. As a result, much effort has been expended in devising methods of beating the cost factor. The system described herein was developed in the author's course in films for television at New York University. Its prime function is making dramatic films and commercials for television.

The generally used, double system, method of making sound films is to photograph the picture on one film—often known as a "mute"—and the sound on a separate film. After processing, sound and mute prints are edited and a composite print is made comprising both sound and picture. This is the preferred method since it allows the most suitable emulsion and processing to be used for sound and picture reproduction, and equally important, the two prints can be edited separately. This method costs more money since twice as much film footage is used in the studio, in addition to the fact that an extra composite film has to be made from which release prints are made. Additionally, a clap-stick has to be used to indicate synchronizing points on the mute and the sound prints, and these marks have to be retained as long as possible during editing.

Conversely, in the single system the picture and sound are photographed on a single film simultaneously. This reduces cost by eliminating one of the films required by the double system, and the composite print which combines sound and picture in the latter. However, editing single system film embodying lip synchronized scenes produces some difficulty in retaining the 26 frame sound lead when cutting at the end of sequences. Also, by virtue of the fact that both photographic images have to be processed at the same time and on a compromise emulsion, optimum sound track and picture definition may not always be obtained. For events such as parades, or newsreel interviews, single system sound is very convenient. For dramatic productions in which there is continual intercutting from actor to actor, combined with varying angles and lens changes, it introduces editing difficulties. However, it can be done satisfactorily by careful arrangement of the overlap periods at the end of each sequence.

Single System Sound

In view of the ever present need for economical television film production, single system sound appears to offer an ideal method of filming low cost shows because only *one* film need be used. This is partially true, for if the play runs as a continuous production, the camera can film continuous sequences, and shoot the whole story without introducing any problems of sound lead overlap between scenes. But this precludes the use of any lens changes for close-ups, or the use of effects such as fades, and dissolves. In television, close-ups are an essential, but a play consisting of all close-ups would be almost as bad as one without any. If it were possible to stop the camera to take close-ups or other angle shots, etc., production would be enhanced, but it

FILMS FOR TELEVISION

Film is becoming increasingly important in television. NTFC estimates that within a short time 75% of all programs will be on film.

TV needs greatly improved methods of film recording and transmission to take advantage of the benefits of "canned" programs.

The problem of converting film speed of 24 fr. per/sec. to TV speed of 30 fps. complicates projector design, and until more progress is made in this field, TV films will not be acceptable as live shows.

The major manufacturers recognize this fact and showed many new designs at the May, SMPTE Convention in New York, as well as the NARTB Convention in Chicago.

"Economy" methods such as the one described in this article may be the answer to television's problem of good low cost programs.

Adapt TV Techniques

to offer prospects of economy TV film production by applying a modified version of live TV operation

would introduce difficulties in editing. This is one of the reasons why most of the "economy systems" use double system sound.

The method under discussion is a logical development of this requirement. It might be called a "double-single-system" in that single system sound recording is used, but at the same time a form of double system camera operation is in progress since two cameras are used.

Two variations are described. The first is a variation of the continuous single system proposed by the makers of the Auricon, and the second a combination double single system. For productions requiring a protection print, or more than one copy of film, the latter system should be used. But in cases where only one copy is required, and in a hurry, the single system version is very suitable.

In the first application, two Auricon "Pro" cameras are used, each of which records single system sound and picture. The "slave" camera runs intermittently to obtain angle shots and close-ups, etc., as required by the script. Thus the continuous run feature of live television is retained together with part of the economy of single system operation.

Operation of Slave

The conditions surrounding the operation of the slave camera require preparation on the part of the producer in deciding in advance where the camera changes will occur. However, this is a normal part of preparing for film production. Camera takes are controlled by the producer or chief cameraman who, following his script, is able by the operation of a switch to control operation of the slave camera. For instance, the film may open with a medium shot of an orchestra. With only one camera this shot, with variations produced by dollying would constitute the sum total of angles and lenses available for the film. However, when the slave is started and run up to speed, a shot from it can be made with any desired lens from close-up to long-shot. All this time, the master camera is recording the sound track as well as a shot of the subject. Therefore, if the slave shot should be spoiled there will still be a picture and sound record.

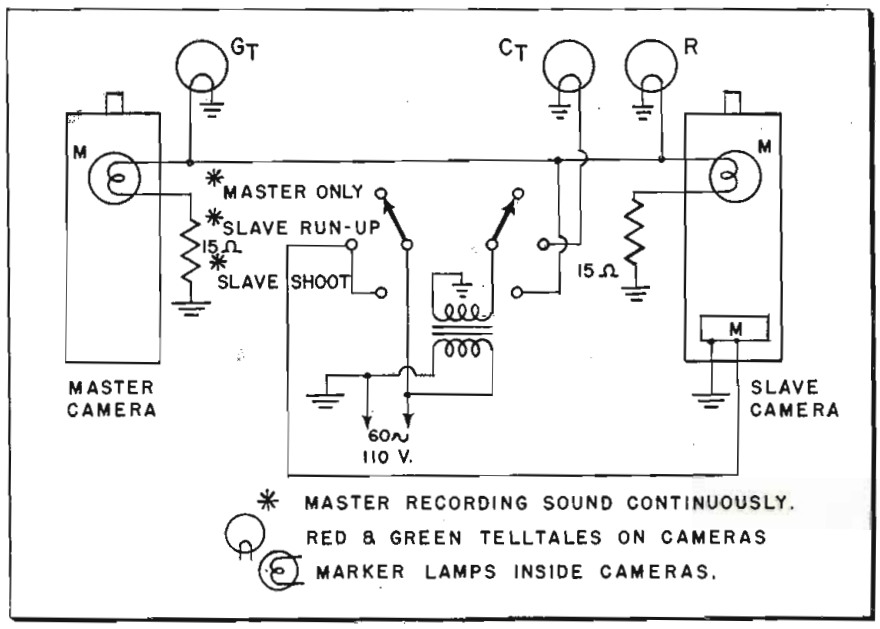


Fig. 2: Schematic drawing showing circuit connections of the master and slave cameras. Control box contains transformer for pilots, etc., and was recently modified

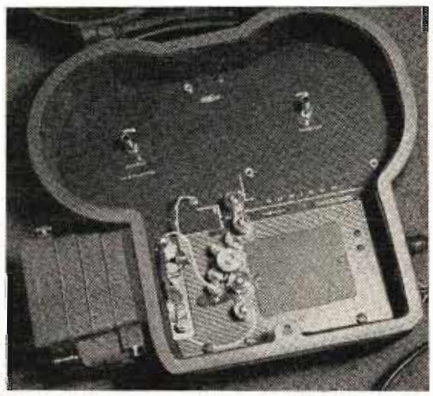


Fig. 3: Auricon "Pro" camera, silent model. The white leads passing through the magazine mounting holes were used for test purposes and were replaced later

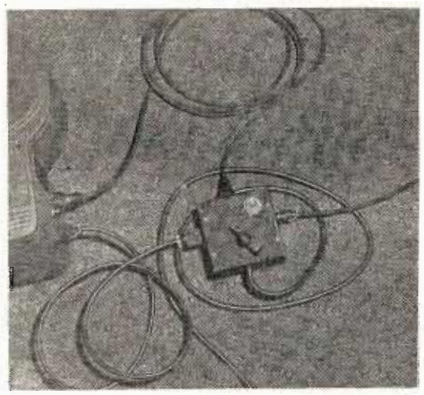


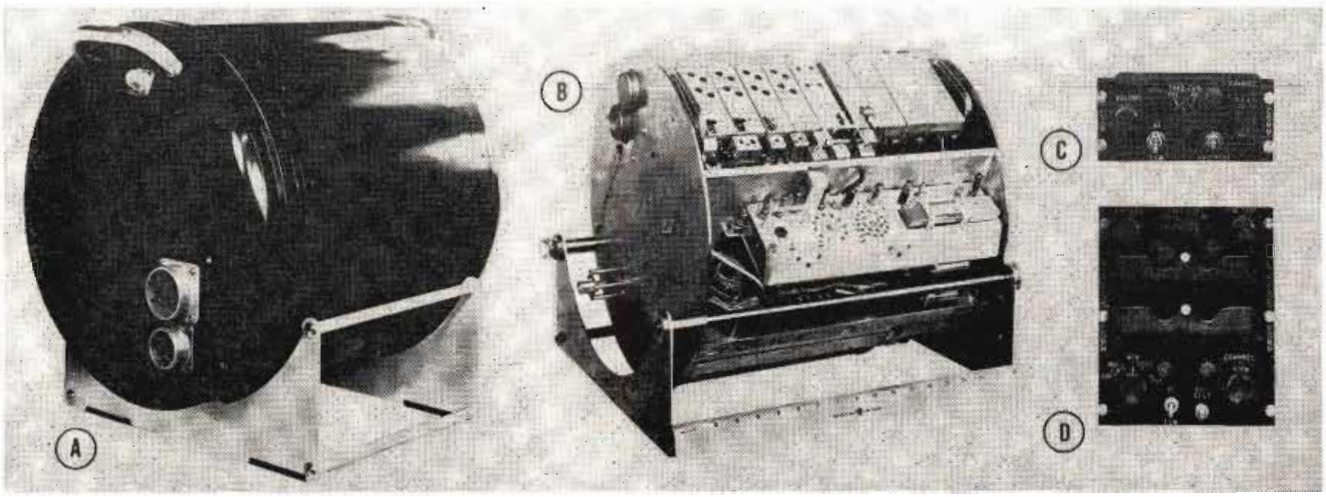
Fig. 4: Switch on control box has three positions: "off"; "slave run up"; and "slave shoot". Later versions have corresponding lights for the director on box

Fig. 3 shows the interior of one of the Auricon "Pro" cameras—in this case a silent slave. The only addition to the mechanism is the marker lamp holder which uses a TL-3 focus bulb mounted beside the picture gate so that the beam from it marks the perforation edge of the film. The pressure plate from the gate is pierced by a #60 drill, thus allowing a very small beam of light to fog the edge of the perforation. The sides of the bulb are painted jet black with non-reflecting paint so that only a minute dot of light reaches the emulsion to eliminate any risk of fogging. This fitting is also in-

(*Continued on page* 66)

Design Trends in Military

Engineering emphasis is on subminiaturization and reliability. Frequency New communication concepts provide for airborne radio relay systems



At (A) subminiature liaison transceiver, (B) transceiver with cover removed, (C) pilot's control panel, (D) master control panel

By ***GEORGE H. SCHEER, JR.,*** *Chief, Equipment Branch,*
Hq. Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio

THIS discussion will cover, in general, two classes of military airborne communications equipment. The first of these, short-distance or line-of-sight equipment is commonly employed in the VHF and UHF spectrum, while the second, long-distance equipment operates between 2 and 30 MC in the medium and high frequency spectrum.

Up to the present time, line-of-sight experience has been only in the VHF region, where crystal control for adequate stability has been used. Such control was furnished in the form of plug-in quartz crystal units without temperature control. For each channel, two crystal units were required, one for the transmitter and one for the receiver. In a ten-channel set, then twenty crystal units would be needed in order to make available ten different frequencies. In the VHF portion of the spectrum from 100 to 156 MC, with a channel spacing of 180 KC, there are 312 available channels. In order to be able to use *any* channel, it would require a stock of 624 plug-in crystal units for each radio set installation.

Considerable difficulty was experienced in getting raw quartz in the last war, since almost all of it had to be imported. Such a position is certainly even more undesirable today. Our new equipments in the line-of-sight bands can provide many more channels and if the same circuitry were used as in earlier VHF equipments, a staggering number of plug-in crystal units for each transceiver would be needed. Even with our synthetic growing of quartz, there would be the problem of finishing the blanks and assembling the final crystal unit. These problems led to efforts for an avenue of escape and have resulted in circuitry for frequency synthesis.

Frequency Synthesis

It's quite feasible to mix fundamentals and harmonics of different crystal units to obtain a great variety of control frequencies. When these are properly chosen, the required number of crystal units are easily reduced to a reasonable figure. In addition, these crystal units are not plug-in in the usual sense of the word; they are integral parts of the radio sets, never needing changing, yet providing control for each and every frequency channel when required.

In most frequency synthesizers, when the number of crystal units is reduced below a certain number, the circuit complexity rapidly increases, as does the bulk, so a compromise must be reached. At UHF, this compromise varies between about 15 to 25 integral crystal units, depending on different equipment designs. Yet each equipment will furnish, theoretically, all the required channels.

It is customary to control both the transmitter and receiver with only one synthesizer, resulting in any desired, but fixed, frequency difference between receiver and transmitter frequencies, for any particular channel selected. The use of but one synthesizer has naturally resulted in savings in circuit duplications and the common use of combined transmitters and receivers, that is, transceivers.

The nemesis of most synthesizer schemes is that all the mixing of crystal harmonic and fundamental frequencies usually results also in un-

Airborne Communication Equipment

synthesis is employed to gain more channels with fewer crystals. and mixed frequency transmissions to overcome propagation problems

wanted combinations which, unless effectively suppressed, result in spurious responses in receivers on some of the wanted channel frequencies. This loss of channels may be a very appreciable percentage of the total available number. Good filtering, plus judicious choice of original frequencies for the crystal units to make spurious combinations fall outside the pass band of the receiver, can do much to reduce the number of unusable channels.

Synthesizers

At least one synthesis scheme provides for an almost unlimited number of discrete, controlled frequencies, yet uses only one quartz crystal unit. In a scheme such as this, a very stable, temperature-controlled crystal unit can be afforded since only one is used. Synthesizers of this type are most easily adapted to lower frequencies in the radio frequency spectrum.

Crystal control and frequency synthesis have been applied in the long-distance class of airborne equipments. It takes little imagination to see immediately that maintenance, supply, manufacturing and raw product is reduced by using fewer crystal units, and, therefore, frequency synthesis is here to stay. This does not indicate that there is no room for improvement, however.

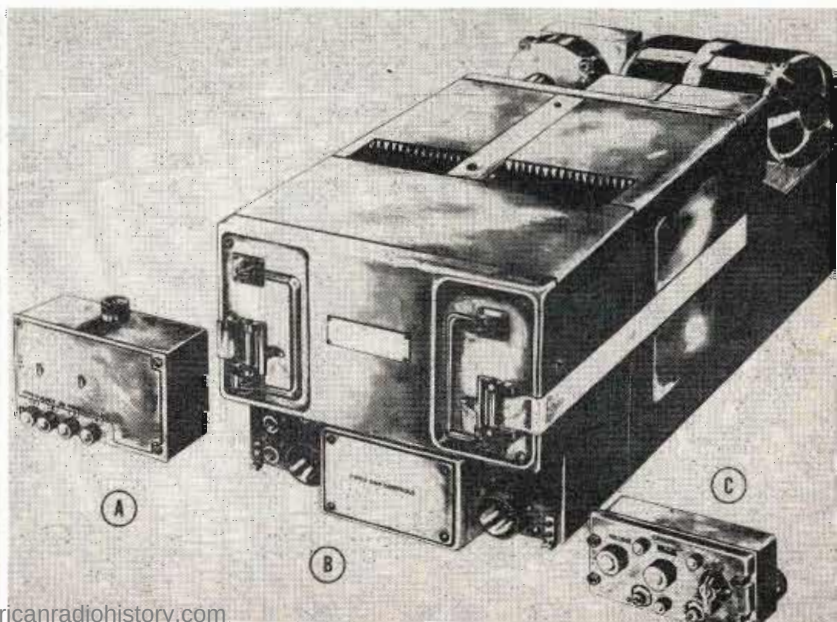
Frequency allocations by FCC spell out the frequency bands for Government uses as well as civilian uses. As military communication operations become more and more complex, there is need for more and more channels, and this, evidently is a continuing process. Such demands, when using amplitude modulation, can be met only by decreasing the bandwidth allotted per channel. When the use of VHF for communications was first considered, channel separations of 400 KC were involved. But now the frequency assignments are on the basis of 100 KC channel separation. Should there still be too few available frequencies in the assigned band, it is likely that 50 KC spacing would be employed to again double the number of available channels. While adjacent channels when transmitters and receivers are closely located still cannot be used by virtue of the receiver selectivity curves, it is not too much of a problem to improve selectivity if need be. At line-of-sight frequencies, the limits of bandwidth required for voice modulation have not nearly been approached.

Our big problem is getting the required frequency stability under all of the possible service conditions which might be encountered in military aircraft flight, such as extremes of temperature (—65° F. to +185° F.), high humidity, and the like. VHF during the last war employed 180 KC channel spacing and .02 of 1% quartz crystals. At 150 MC that meant a plus or minus deviation of 30 KC or a total possible spread of 60 KC if the concerned receiver and transmitter drifted in opposite directions. Today, an .02 of 1% crystal unit would give us plus or minus 100 KC or a possible separation of 200 KC at a carrier frequency of 500 MC. Normally, the pass band is in the neighborhood of 80 KC, so it is obvious that there might be "netting" problems. The frequency stability must be greatly improved.

Frequency Stability

Where strict requirements for frequency stability are really encountered is in frequency shift keying for radioteletype operation where the pass band is cut to 3500 cps. to reject as much noise as possible, and still pass sufficient harmonics for satisfactory operation. There are available very carefully made quartz crystals installed in thermostatically-controlled, heated ovens. Here we are talking about frequency errors no greater than .0015 of 1% or 30 cps

(Left) Photograph illustrates new combination dynamic noise cancelling microphone and dynamic headset. (Right) A subminiature command transceiver showing channel set-up box at left, transmitter-receiver in center and the pilot's control box at right



at a carrier frequency of 2 MC and actually, the state of the art permits better than .0007 of 1% on transmitters under ordinary service conditions. This is a maximum drift of only 14 cps. at 2 MC.

How much farther we can go with quartz as the frequency-controlling element is a big question. Certainly any more improvement will merely bring us closer to the asymptote. Perhaps a network of highly precise ground transmitters for fixed frequency broadcasts to supply the reference frequencies for the synthesizers in airborne radio transceivers could be utilized. Such a project is hardly feasible economically, and even if it were, such a network would provide very obvious targets which could be jammed easily if the enemy chose not to use the reference frequencies for his own ends. Absorption lines in gases such as ammonia, or even spectral lines, might be used. The former are already being employed for the SHF band. However, the matter of dividing down to present communication frequencies would be cumbersome, plus the fact that the basic frequency determining components would likely be unwieldy. Perhaps the nucleus of the atom, so inherently stable, holds promise for us. The radio art is definitely pushing the frontier in frequency control and what the next step will be is difficult to predict at this time.

Typical airborne dynamic loudspeaker

Antennas

It is not too difficult to design a fairly good antenna at VHF, broadband enough so that over the less than two-to-one frequency band, the impedance match is satisfactory. The problem becomes more severe at higher frequencies, since little, if any, gain can be built into the antenna because of the requirement for omnidirectional coverage. The energy pickup at these higher frequencies will, therefore, be less than at VHF frequencies.

The greatest antenna challenge occurs in the high frequency region where almost four octaves must be covered. This means that a separate tuning and loading system must be provided either as a part of the transmitter or as an adjunct. Such a tuning and loading facility must be adjustable in several parameters in order to match the ouput circuit of the transmitter properly, regardless of the reactance presented by the antenna over the frequency range. This means added controls, to say the least. By means of accurate mechanical positioning devices, it has been possible to preset, say 10 frequencies, any one of which could be chosen for operation. This included preset adjustments to utilize a specific antenna.

Now our equipments must be directly operable by the pilot himself, and must provide for entirely automatic antenna tuning and loading with a wide variety of antennas. The equipment will monitor antenna constants while in operation and will automatically retune and reload in case of antenna icing or battle damage, within its capabilities.

Antennas on aircraft will soon be conspicuous by their outward ab-

(*Continued on page* 78)

Shoran—Invaluable Aid to Navigation

The airborne terminal of a Shoran unit (see cover) is used for high, precision bombing, reconnaissance and aerial navigation. Although its name is derived from *short range*, the equipment will operate at distances up to 250 miles with an accuracy of plus or minus 50 ft.

Shoran is a direct development of investigation and observation of television ghosts by Stuart W. Seeley of RCA. Its operation depends on the accurate measurement of the time taken for a 260-MC pulse to be transmitted by an aircraft, received by two ground stations, and repeated back to the plane. Result of a series of these observations is two arcs which intersect at a point on the scope indicating the plane's position.

It is necessary to fly a slight arc over the target in order to keep one of the coordinates constant; however, at distances of hundreds of miles this curvature is very slight.

A cathode ray tube is used as a presentation unit and since size is important it is limited to an approximate diameter of 3 in. This provides a circular trace about 7½ in. in length.

Page from an Engineer's Notebook

Number 12—Waveguide Taper Design

Nomograms to permit rapid solution of matching problems in rectangular wave guides where wide dissemination is constant and narrow side is tapered

By J. F. SODERO, Project Engineer, Electronic Department
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WAVEGUIDE tapers are used as transition sections between waveguides of unequal cross-sections and as microwave antennas. In both of these applications, the tapered section minimizes the reflections which would result from an abrupt waveguide size change. In the case of a rectangular guide, both cross-section dimensions can be simultaneously flared, or either can be flared while the other is maintained constant. The case to be considered in detail is that in which the narrow side of a rectangular waveguide is tapered while the wide side is held constant. Such a transition is shown in Fig. 1.

In the design of a waveguide taper, it is necessary to determine a suitable flare angle, 2 θ, and this establishes the section length, L, for a given change in waveguide dimensions. The angle is defined as tan $\theta = (B'—B)/2L$ in which B′ and B are the narrow-side lengths. It is desirable to use a gradual taper which tends to reduce reflections at the point of join with the waveguide and to insure the transmission of only the dominant waveguide mode. However, a small flare angle may result in an inconveniently long transition. Therefore, it is important to know the maximum allowable flare angle, and a means of cancelling reflections from the joins.

Design Charts

It has been demonstrated[1] that for angles of 20 degrees or less, the taper mismatch can be effectively reduced by suitable diaphragms. For the case shown in Fig. 1, the reflections from the narrow end of the taper can be cancelled by an inductive diaphragm of depth:

$$d = \frac{A}{2\pi}\sqrt{\frac{A \tan \theta}{2B}} \quad \ldots\ldots\ldots\ldots (1)$$

in which A and B are the wide and narrow dimensions respectively. The angle θ is half of the total flare angle. Equation (1) assumes that the far end of the taper is matched.

A capacitative diaphragm is required at the wide end of the taper if the transition joins to a uniform waveguide. In this case, the required depth is

$$D = \frac{\lambda_g}{2\pi}\sqrt{\frac{\tan \theta}{\pi}} \quad \ldots\ldots\ldots\ldots (2)$$

and the guide wavelength can be determined from the standard equation:

$$\lambda_g = \frac{\lambda}{\sqrt{1 - \left(\frac{\lambda}{2A}\right)^2}} \quad \ldots\ldots\ldots (3)$$

Fig. 2 is a nomogram for the solution of equation (1). It is used by selecting waveguide dimensions on scales A and B and constructing a straight line between these points. The intersection of this line with the K scale determines a turning point. A straight line from this point to the desired flare angle on the θ scale intersects the d scale and indicates the required diaphragm depth.

The nomogram for the solution of equation (2) is shown in Fig. 3. The guide wavelength value is selected on the λg scale and the desired flare angle on the θ scale. A straight line between these two points shows the required diaphragm depth on the D scale.

See following page for Nomograms (Figures 2 and 3)

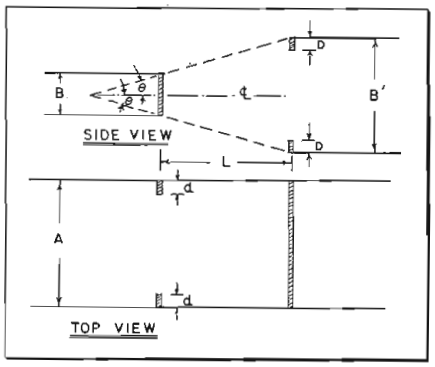


Fig. 1: Narrow side taper

Determine the diaphragm depths required to compensate a 1-in. by 3-in. waveguide when the narrow dimension is flared to a larger size by means of a 10-degree half-angle taper for 10-centimeter radiation.

Select 1 on the B scale and 3 on the A scale of Fig. 2, and connect these points by a straight line which intersects the K scale to determine a turning point. Connect the turning point with 10 on the θ scale by a second straight line, and read the required diaphragm depth of 0.28 in. on the d scale.

The inductive diaphragm depth can be determined from Fig. 3 after the guide wavelength has been calculated from equation (3). A free space wavelength of 10 centimeters will have a 13.2-centimeter wavelength in a guide with a wide dimension of 3 inches. From 13.2 centimeters on the λg scale to 10 degrees on the θ scale, construct a straight line which intersects the D scale at 0.195 inches. This is the required diaphragm depth.

1. L. Lewin, "Reflection Cancellation in Waveguides," Wireless Engineer, PP 258-264—8/49.

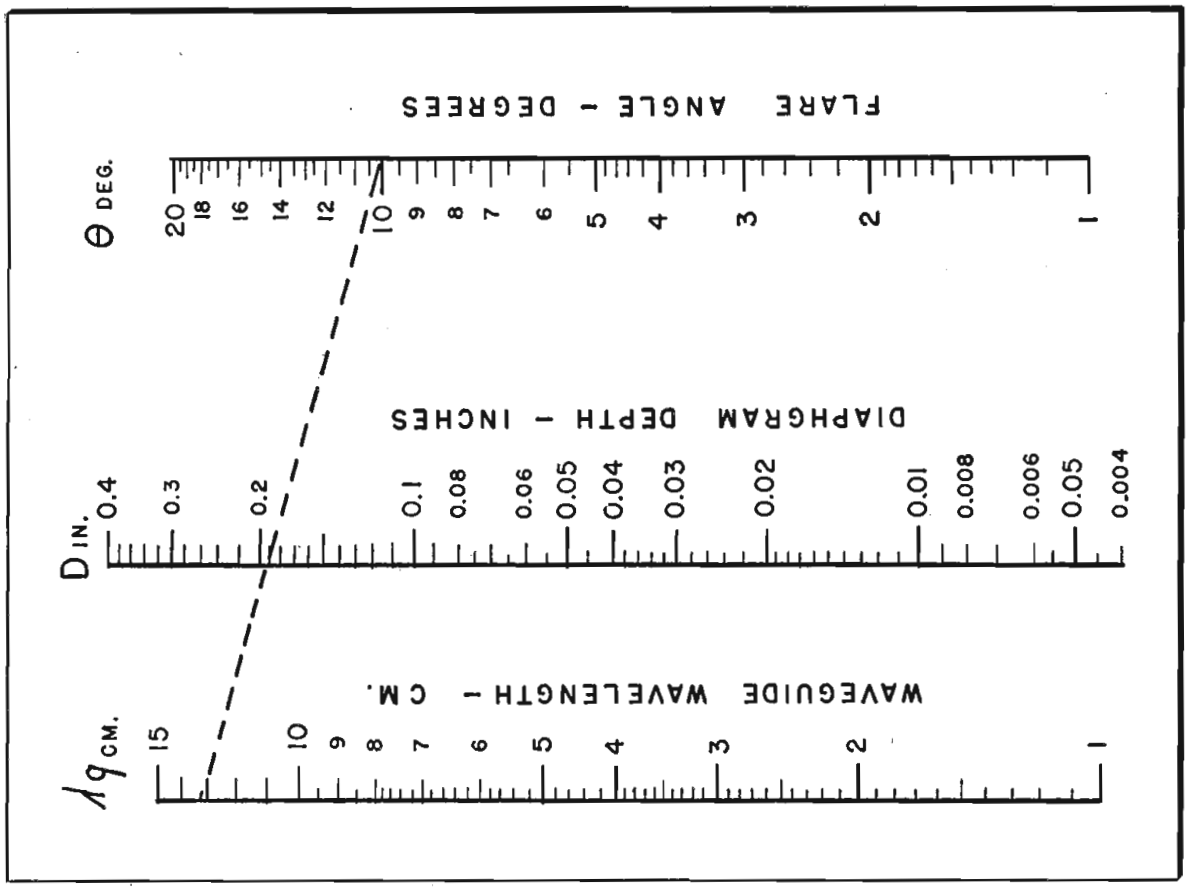


Fig. 3: (Right) Nomogram for the solution of equation (2). The guide wavelength value is selected on the λ scale and the desired flare angle is selected on the θ scale. A straight line between these two points shows the required diaphragm depth on the D scale

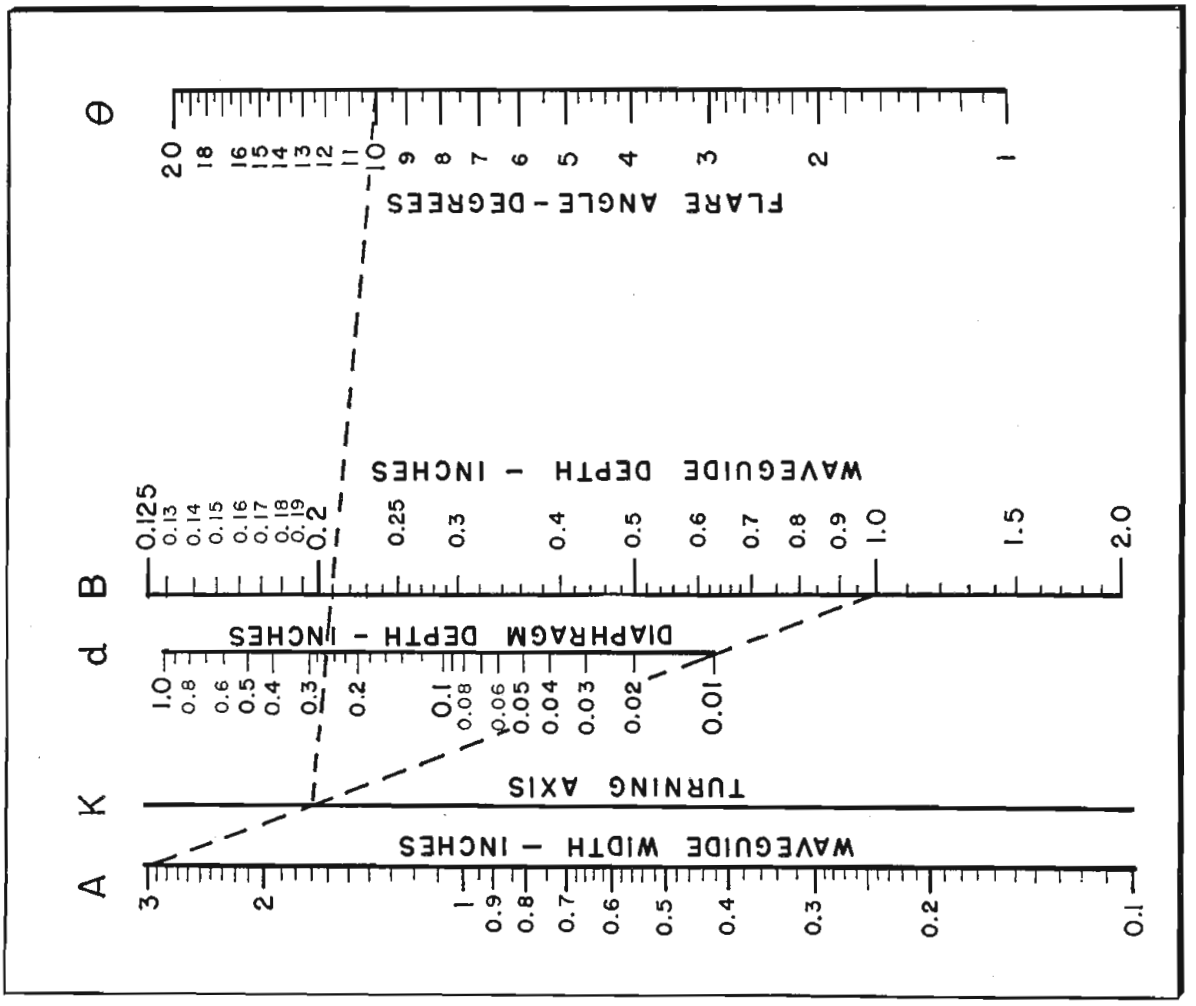


Fig. 2: (Left) Nomogram for solution of equation (1). Select waveguide dimensions on scales A and B and construct straight line between these points. Intersection of this line with K scale determines a turning point. Straight line from this point to desired flare angle on θ scale intersects d scale and indicates required diaphragm depth

Improved Electron-Gun Ion Traps

New "offset" cathode ray tube gun design assures spot roundness. Externally fluorescent coated anodes are equally effective as visual indicators for correct magnetic beam bender adjustment

By C. S. SZEGHO and T. S. NOSKOWICZ
The Rauland Corp., Chicago, Ill.

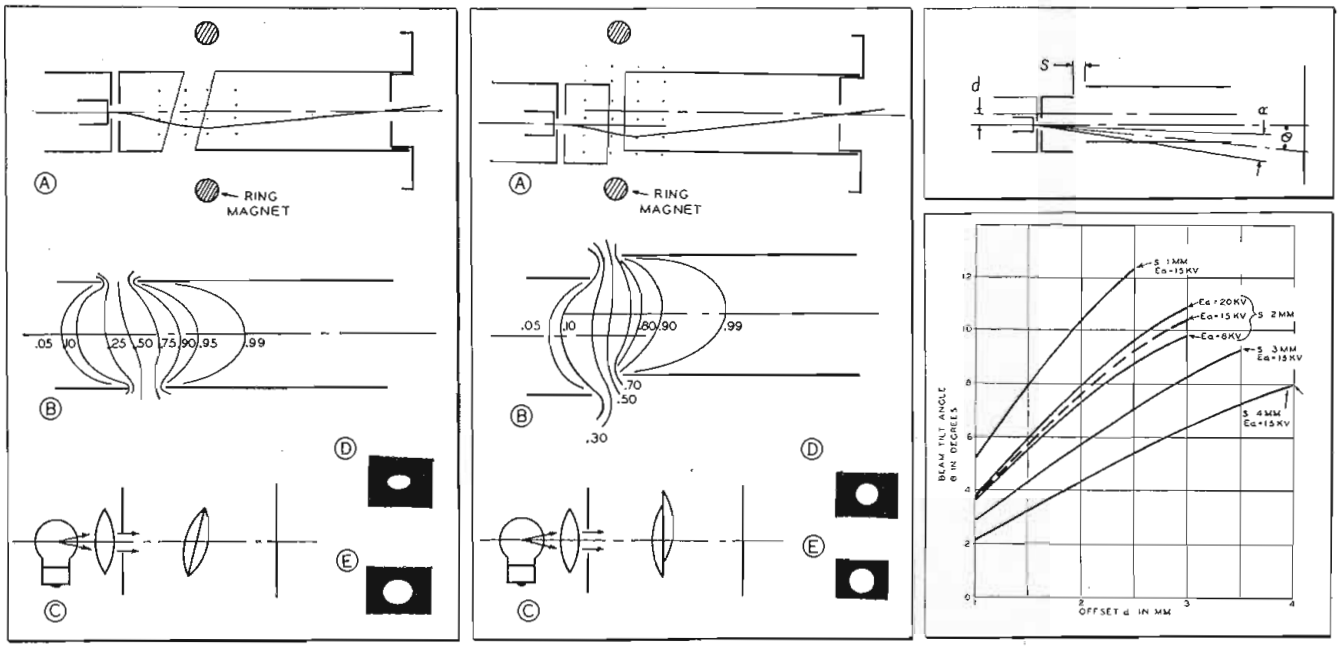
IT is well known that negative ions in the beam of high vacuum cathode-ray oscillograph and television picture tubes may cause a fatigue effect or blackening in the center of the fluorescent screen.[1,2,3] In order to avoid that effect it has been proposed that the principle of the mass monochromators and spectrographs be used to separate negative ions from electrons and prevent the ions from reaching the screen. These instruments employ a combination of electric and magnetic fields and take advantage of the fact that electrons and ions having the same energy and charge are deflected by electrostatic fields to an equal extent irrespective of their mass, while magnetic fields deflect electrons to a greater extent by a factor proportional to the square root of the ratio of the mass of the electron to that of the ion.

In one class of such instruments, used by Wiechert as early as the end of the last century, the rays were produced by an axial electrostatic field and were bent by a transverse magnetic field.[4] The bent-neck or bent-gun variety ion trap for television picture tubes employs the same general principles.[5]

J. J. Thomson has described another class of these instruments in which transverse electric fields, together with transverse magnetic fields are used for the determination of charge to mass ratios of corpuscular rays.[6] Ion traps for cathode-ray tubes based on this technique deflect the ions against an obstruction by means of a transverse electrostatic field and guide the electrons alone towards the fluorescent screen by one or more transverse magnetic fields.[5] Ion traps using this broad principle take a variety of forms and may be classified according to the location of the influencing fields along the electrode system of the tube. There are two principal types of electrode systems in use for television picture tubes: triodes and tetrodes, the latter including an additional grid between the control grid and the anode. The transverse electric and magnetic fields of the ion trap may be established between the anode and the fluorescent screen; between the control grid and anode;[7] or between the second grid and the anode.[8]

The ion trap illustrated in Fig. 1a, for example, provides a skew field having a transverse electrostatic field component between the second grid and the anode. This trap structure, which is referred to as a "tilted lens", is coaxially mounted in the neck of the tube and deflects the mixed beam of ions and electrons

Fig. 1: (Left) Tilted lens ion trap (a) electrode system (b) plot of equipotential lines (c) optical analogy (d) photo of light beam cross-section (e) photo of cross-section of pre-focused beam on screen of 16AP4 tube with 12 KV anode voltage and 200 μa pulses
Fig. 2: (Center) New "offset" ion trap gun (a) electrode system (b) plot of equipotential lines (c) optical analogy (d) photo of light beam cross-section (e) cross-section of pre-focused beam on 16AP4 screen with 12 KV anode voltage and 200 $\mu\alpha$ pulses
Fig. 3: (Upper right) Relation between offset and spacing of G_2 and anode, beam tilt angle Θ and beam divergence α in new gun
Fig. 4: (Lower right) Curves showing beam tilt angle Θ as a function of offset and spacing between G_2 and anode of new gun



away from the tube axis, but the electrons are returned by a magnetic field and are guided through an aperture in the anode as indicated. Potential surfaces of this lens are shown in Fig. 1b. The aperture plane of this tilted lens is inclined, as distinguished from being perpendicular, to the principal ray of the electron beam, thus causing an elliptical distortion of the beam cross-section.

Optical Analogy

An optical analogy is shown schematically in Fig. 1c, and a photograph of the elliptically distorted cross-section of the bundle of light is reproduced in Fig. 1d. The major axis of this ellipse is parallel to the major axis of the projected cross-section of the lens. To illustrate the corresponding effect in the electron optical case, the unfocused spot on the fluorescent screen was photographed (Fig. 1e) with the customary voltage of 300 V on the second grid and 12 KV on the anode of the tilted-lens gun. The transverse magnetic field is produced by a ring-shaped magnet and is homogeneous in the vicinity of the beam with its axis carefully aligned about the axis of the beam as it emerges from the cathode. One can see that the beam, as prefocused by the tilted lens, has an elliptical cross-section. The major axis of the ellipse is parallel to the projected major axis of the tilted lens itself, as in the case of the optical analogy.

This elliptical distortion is avoided by a different gun structure in which the cathode, control grid, and second grid are coaxially aligned but the anode axis is positioned to one side of and parallel to the common axis of the cathode and grids, all electrodes having circular cross-sections, as shown in Fig. 2a. The equipotential surfaces of this structure are plotted in Fig. 2b. The mixed beam of ions and electrons from the cathode first travels parallel to the tube axis but offset from the latter and is then deflected by the transverse component of the electrostatic field between the second grid and anode toward that side of the anode which is nearer to the axis of the grids. The electrons alone are bent back toward the tube axis by a transverse magnetic field and are directed through the limiting aperture of the anode.

An optical analogy for this lens is the "rising front" arrangement often used in photography and schematically illustrated in Fig. 2c. The photograph of the cross-section of the light bundle passing through this lens shows good circularity, Fig. 2d. The unfocused spot which this offset-lens electron gun structure gives, taken under the same conditions as for the tilted-lens gun, shows equally good roundness, Fig. 2e.

Spacing Tube Elements

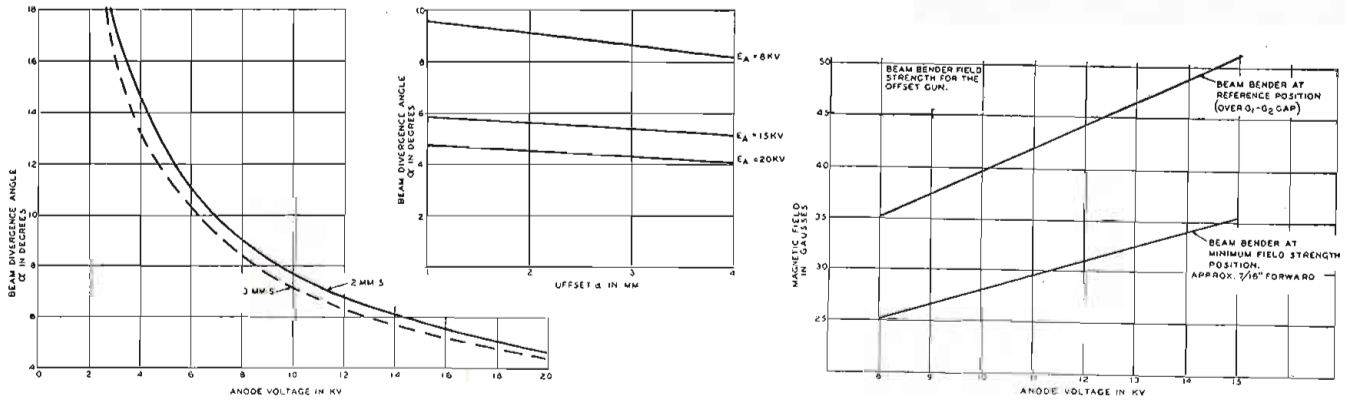
In the last-described gun, the angle of the mixed beam referred to the gun axis depends on the amount of offset between the grids and the anode, the separation of the second grid and anode, and the voltage difference between these electrodes. A tube was constructed in which this "offset" and spacing could be varied by moving the anode which had no limiting aperture along two coordinates with the aid of magnets positioned outside the tube envelope. Fig. 3 shows the tilt angle θ of the mixed beam, the spacing s between the second grid and the anode, and the "offset" δ which is the distance between the axes of the second grid and the anode. The angle θ was determined by observing the excursion of the spot on the fluorescent screen.

Fig. 4 is a plot of this angle θ as a function of the offset with spacing s as a parameter. The anode voltage has only a minor influence on θ, as is apparent from the curves shown for various voltages at 2 mm. spacing. The spread of the beam or the divergence angle α depends on the anode voltage and, to a lesser degree, on the spacing between the second grid and the anode. The maximum divergence angle, that is, the angle at zero bias, has been measured and is plotted in Fig. 5a as a function of anode voltage at various spacings but with no offset. It has been found that the amount of offset has negligible influence on the beam divergence, as demonstrated in Fig. 5b. The ion trap is then effective if, at maximum beam current, no part of the mixed beam can pass through the limiting aperture in the anode.

The "trapping voltage", that is, the anode voltage at which the mixed beam completely misses the aperture with zero bias, must be low to make sure that no ion spot develops during the switching on and off periods of a television set. The offset spacing must be so chosen that in the working anode voltage range the trapping can be accomplished at minimum beam angle θ, which will be approximately half of the divergence angle α at the trapping voltage chosen. The design of the new gun was based on a trapping voltage of approximately 2 KV, but future experience may show that this is too conservative. Increasing the trapping voltage to around 6 KV may become feasible with corresponding improvement in the image-forming properties of the gun.

The transverse magnetic field, which bends the separated electrons of the mixed beam back towards the tube axis, may cause them to overshoot and miss the center of the fluorescent screen.[9] To compensate for

Fig. 5a: (Left) Curves showing the beam divergence angle α as a function of anode voltage and the anode to 2nd grid spacing of new gun. Fig. 5b: (Center) Beam divergence angle α as a function of offset with the anode voltage held as a parameter Fig. 6: Beam bender field strength required for various anode voltages in the new offset gun. Data is shown for two positions



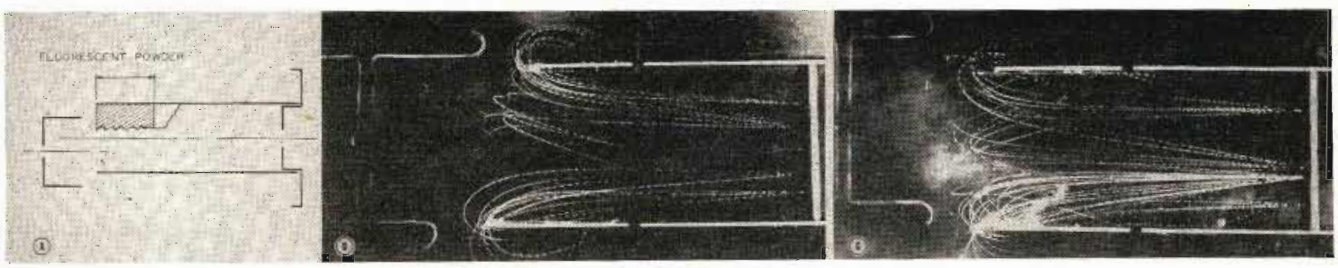


Fig. 7: Indicator type ion trap gun showing the (a) location of fluorescent powder used to indicate the correct beam bender adjustment (b) trajectories of electrons reflected by the limiting aperture in the tilted lens gun as shown on a rubber model (c) Trajectories of electrons reflected by the limiting aperture in the new offset gun as illustrated on a rubber model

this, one can either apply a second, weaker and opposing magnetic field or tilt the entire gun by an angle which is equal and opposite to the overshoot angle. Both artifices may be employed with the new gun. As the double magnet assembly takes up more room, it is preferred to employ a single magnet and to tilt the gun structure. The magnetic field strength necessary for this single magnet, if it is located over the second grid, is plotted in Fig. 6 (upper curve). The required field strength is less if the magnetic field is shifted approximately ½" towards the screen (lower curve).

Correct Alignment

The importance of the correct alignment of the electron pencil by the beam bender magnet has already been pointed out in a previous article wherein an arrangement is described for facilitating alignment.[10] In accordance with that arrangement the limiting aperture is coated with willemite. When all the electrons pass through the opening, this fluorescent deposit ceases to glow and thus correct alignment is indicated. Certain drawbacks of this arrangement were recognized and enumerated. The glow must be observed through the gap between the second grid and anode which may be obstructed by the magnet positioned in that vicinity. The high intensity bombardment of the deposit may cause the release of gases and deterioration of the fluorescent powder. If fluorescent particles become lodged at the inner edge of the aperture, the beam may acquire "ragged edges". Finally, flourescent particles may fall on the cathode coating and impair emission. An improvement of this indicator feature overcomes these drawbacks. It has been discovered that it is not necessary to deposit the fluorescent coating on the aperture disc at all, but instead the external surface of the anode cylinder may be coated, as shown in Fig. 7a. This is highly advantageous since there is no direct impingement of the fluorescent coating by an intense beam, no deleterious gases are given off, ragged edges are avoided, and the glow is readily observable.

As at first glance it appears surprising that the electrons can impinge on the outside of the anode at all, the electron trajectories were investigated in a rubber model. The trajectories of electrons reflected from the aperture disc of the tilted-lens ion trap anode and of the offset ion trap anode are shown in Figs. 7b and 7c respectively. Steel balls coated with fluorescent material, which acquired kinetic energy approximately equal to the energy which reflected electrons would have, were discharged down an inclined plane towards the cathode. The fluorescent coating of the balls was transferred to the rubber sheet during traversal and was excited by ultra-violet light and photographed. It can be seen that the reflected electrons are deflected by the potential mould between the second grid and the anode and do land on the outside wall of the anode. The reflected electrons thereby fulfill the role of an indicator which denotes correct alignment of the beam bender as indicated by a distinct minimum in the glow. If all beam electrons go through the aperture, there are no reflected electrons and there is no glow.

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Plummer Named Chief of Broadcast Bureau

Curtis B. Plummer, present chief engineer of the FCC, will head the Commission's new Broadcast Bureau. He joined the Commission in 1942 and became chief engineer in April, 1950.

This integrated new bureau will consist of an Office of the Chief and five divisions: an Aural Facilities Division; a Television Facilities Division; a Renewal and Transfer Division; a Hearing Division; and a Rules and Standards Division.

The Broadcast Bureau will unify work pertaining to radio broadcasting which has heretofore been handled by various legal, accounting and engineering units within the Commission. This will mean the abolishment of the separate broadcast divisions now under the General Counsel, Chief Accountant and Chief Engineer, and the transfer of their personnel to the new bureau.

Under the new setup all broadcasting activities will be supervised by a single organization.

This should result in a considerable speeding up in handling broadcasters requests and applications and will place the final decision in the hands of a man who knows what the score is from the broadcaster's point of view. Having an engineer at the head of the division is probably the most sensible decision the FCC has handed down for a long time.

CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Edited by John H. Battison

Remote Amplifier Controlled from Studio

D. W. HOLBROOK, Chief Engineer, WLDY, Ladysmith, Wis.

QUITE often, especially in small stations, limited budgets and personnel make it desirable to cut down on remote expenses, and man hours in particular. By using a variation of the standard relay controlled amplifier, a much more flexible remote can be handled by the studio man. The circuit shows a relay at the remote point, which is polarized by a selenium rectifier. The studio control man can select either one of two microphones by using the polarity reversing switch at the studio.

This system is used by WLDY in a Sunday morning church remote and is incorporated to switch microphones between the pulpit and the choir. By using only one microphone at a time a lot of noise and unbalanced music is eliminated.

Filament type tubes are used to permit an "ON AIR" light to be used. When the control operator announces the program from the studio he uses the polarity reversing switch, which has a neutral or "OFF" position. Or he can set that up in advance and use the push buttons on the console to select the line. Two 45 volt hearing aid batteries and one number 6 dry cell are used. In eighteen months the batteries have been changed once and there have been no tube failures.

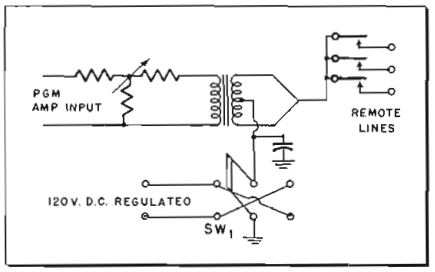
To switch microphones during a program the operator should be acquainted with the program. To transfer from one mike to the other he fades the mixer down, reverses the polarity to the line, and brings the mixer up. There is no noticeable break in the program.

A good ground is needed at both ends of the line. WLDY is located outside the city and has no common water system with the church. Cooperation of the local telephone company is therefore essential to obtain a metallic circuit.

The amplifier shown is very compact. It was built in a metal box acquired at a local hardware store. The box has a lock making it tamperproof. The amplifier is installed in the base of the pulpit with the "ON AIR" light mounted in view of the minister and choir master.

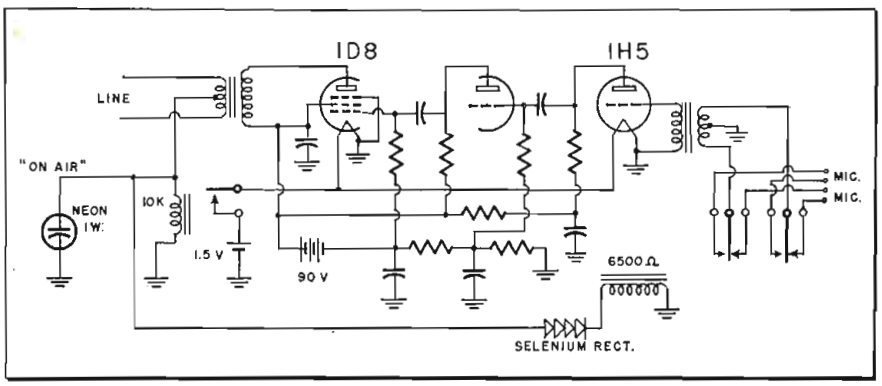
$$$ FOR YOUR IDEAS

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Typewritten, double-spaced text is preferred. Our usual rates will be paid for material used.



Studio end circuit of remotely controlled amplifier. D.P.D.T. Switch selects mike

Circuit of remotely controlled amplifier showing polarised relays and pre-amp



Unattended Remote Amplifier

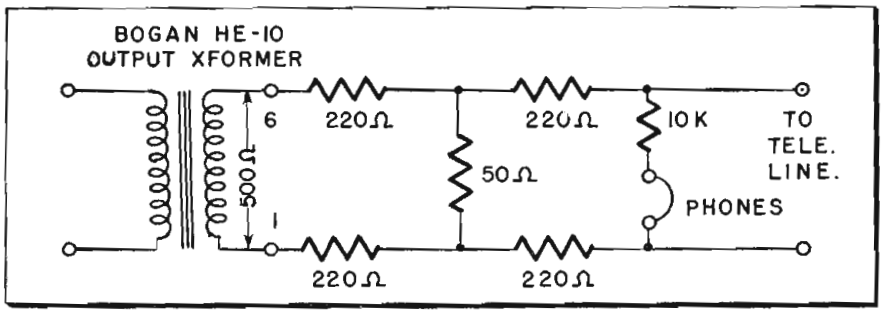
ARTHUR P. DIETZ, Chief Engineer, WANN, Annapolis, Md.

WITH several minor alterations in wiring, the Bogan HE-10, 10 Watt, PA Amplifier can be used as an inexpensive, permanently installed, and unattended, high quality remote amplifier. It can be used for remote broadcasts from local newspaper offices, programs from police stations, municipal offices, or either local or distant churches with excellent results.

After installation, the amplifier can be operated by *one* person at the remote location by turning *one* switch. The Newscaster, police officer, city official, or minister can hear his own cue on the headset, or if the distance is too great for suitable cue level on the telephone line, a small broadcast receiver fixed-tuned to the station concerned can be employed.

Excellent results from this system have been obtained by using the Shure, Model 51 microphones, but any high impedance dynamic or even ribbon microphone should prove satisfactory. Either one, or two microphones may be used and no trouble from internal or external noise, hum, extraneous pick-up, or distortion has been experienced with as many as seven of these amplifiers operating continually for over a year.

For use with two Shure, Model 51 microphones, a "Y" type mike connector is screwed into the single mike connector mounted on the amplifier chassis. One side of the 500 ohm secondary winding of the output transformer must be disconnected from ground and a 25 DB pad inserted. A headset (preferably crystal) in series with a 10,000 ohm isolation resistor can be connected across the output of the pad for cue, and to check the operation of the amplifier. The phono and tone controls should be disconnected as a precautionary measure. During the first on-the-air broadcast, the exact setting of the volume control for proper line level from its half open position when using Shure 51 microphones can easily be determined through instructions from the studio control operator over a near-by telephone. The volume control can then be sealed with *Scotch tape*. Variation



Unattended remote amplifier headphone cue connections and matching network

in level during the broadcast can be controlled by the operator at the studio control board. After the initial installation all that is necessary to put the amplifier into operation is for the broadcaster to switch on the AC switch.

For use with one Shure 51 microphone, the 4.7 megohm resistor connected across the 6SJ7 pre-amplifier control grid should be reduced to approximately .2 megohm.

Tap #1 on the secondary of the output transformer must be disconnected from ground. The 25 DB pad can be mounted on a terminal strip with the output lugs of the pad soldered inside the amplifier directly to the lugs of the 5 prong female socket. The telephone line can terminate in its companion male plug.

Checking Transmitter Rectifier Tubes

GENE RIDER, Chief Engineer, WQAM; and WQAM-FM, Miami, Fla.

ARC backs in rectifier tubes that have been in use for some time are often a major source of transmitter failures. Here at WQAM, we've found this quickly built test gadget very useful in checking the 8008 rectifiers used in both our AM and FM transmitters. The following parts are needed: An isolation transformer, filament transformer, a variac that will give an adjustable output of 0 to 75 v., a 50 ohm current limiting resistor, a 50 ma dc meter, a tube socket and the tube to be tested.

In testing 8008 rectifiers (or 872As —same characteristics — different sockets), slowly increase the applied voltage from zero up to the point where dc current just begins to show on the milliammeter. The peak value of the RMS voltage registered on the voltmeter at this point where current just begins to flow is the initial breakdown voltage.

The peak breakdown voltage for a good tube should average 10 to 15 v. When a test shows a breakdown voltage of 30 v., begin weekly tests on this tube. When the breakdown voltage reaches about 50 v., it is usually courting trouble by operating it in the transmitter.

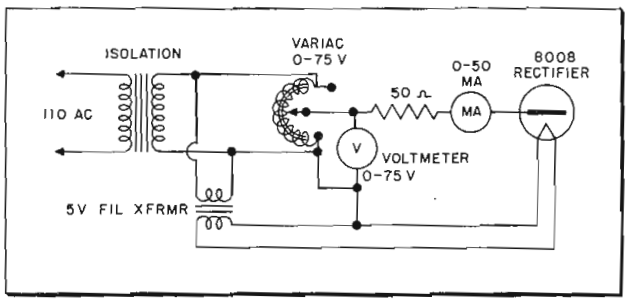
Low Voltage System for Electric Clocks

PAUL A. WILLIAMS, KPIX, San Francisco, Calif.

IN a recent studio installation, it was planned to use Telechron synchronous electric clocks for program timing in a number of locations. After installation of the electrical wiring, however, it was discovered that provision of the necessary circuits had been forgotten. Since spare pairs were available in telephone cables to the required locations a low voltage clock system was installed and proved entirely satisfactory.

A filament transformer of sufficient rating to carry the entire clock load was installed adjacent to the cable terminal and each pair feeding a clock provided a nominal 6.3 volt supply. A small filament transformer was then installed in each clock case, wired in reverse to step up the incoming voltage sufficiently to operate the clock motor. Separate fuse protection was provided for each circuit and the clock plugs and circuit terminations were equipped with midget twistlock plugs to prevent confusion with standard ac receptacles.

An added advantage of this system became apparent when it was desired to change all clocks to daylight time; the main circuit was opened, all clocks set manually to a given time, and then all started together by closing the main at a time signal. This system may be of value when it is desired to provide clock service in new locations without the necessity of running new conduit; the circuits are of such low voltage and power rating to permit the use of almost any practical size conductors.



Circuit for testing 8008 tubes to check peak breakdown voltage. When this rises to 50 volts or more, it is time to discard tube

Foot Switch Aids Cueing

R. S. HOUSTON, 18 Oak Lane, Haverstown, Pa.

IN the case of broadcast control operators whose duties include handling the announcers' mike switches, as well as turntables, traffic sometimes requires "extra" hands. Use of foot switches can ease rush periods when cueing up and playing records and transcriptions. The output of the transcription preamplifier is fed to double throw switch which changes over the preamp output from the air to the cueing circuit. When the switch is depressed, the pickup is cut off the air, and placed on the cue speaker.

The pedals were constructed out of rough wood, hinged at one edge and weighted if necessary to keep them from "walking". The switch used was a rapid make break type of the variety found quite freely on the surplus market. These are completely foolproof, respond to a feather touch, and were quiet enough to be used with a live mike present, in cases where the announcer cues his own discs. They were placed near the edge of the table concerned and slightly hidden underneath so that they could not be damaged by accident. Alongside these were two foot switches similar to those sold for photographic darkrooms for operating enlarger or safelights. These have an on-off action, requiring one pressure for each position. These switches are used for the motors, and thus free the hands for other operations, such as the transcription fader and mike switch. They work well with instant-start tables, and with a little practice, could be used satisfactorily with slow-start tables without the necessity for holding the discs.

Low-Voltage Tunable X-Band

New PAX5 types weigh less than 2.5 lbs, are tunable from 9300 power output of 50 watts minimum. Stability is ±3 MC over

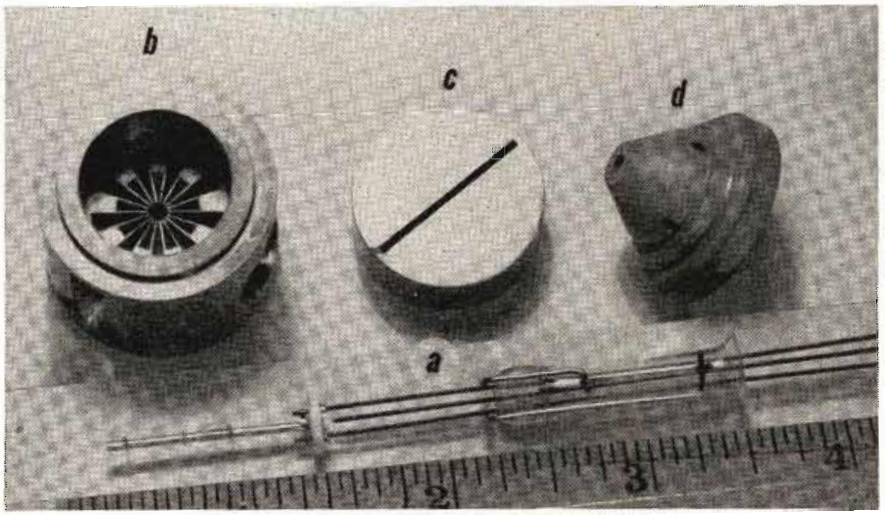


Fig. 1: Parts comprising the type PAX3 magnetron. Shown in photo are (a) cathode assembly, (b) cavity, (c) quarterwave transformer, and (d) conical pole pieces

By GEORGE A. ESPERSEN and BERNARD ARFIN
Philips Laboratories, Inc., Irvington on Hudson, N. Y.

THIS paper is concerned with the development of a tunable, small size, light weight package beacon magnetron required to operate at a nominal frequency of 9310 MC and be tunable from 9300 to 9320 MC, with a minimum peak power output of 50 watts. A stability of ±8 MC of the nominal frequency under the standard pushing and pulling tests and under temperature variation of ±40°C. was required. Variation of the duty cycle, with the temperature remaining constant, was not to change the frequency more than ±1 MC from an interrogation rate of from 500 to 1500 coded signals per second, each consisting of from one to four 0.5 microsecond pulses, spaced 15 microseconds apart.

It was desirable to operate the tube at an anode voltage of 800 volts at 30% efficiency with a heater rating of 6.3 volts, 300 ma and to limit the total weight to 2½ lbs.

In considering the design of a magnetron which will meet the specifications, the rising sun type of anode was chosen in preference to the strapped anode version because:

1. It is possible to scale the tube from existing designs of similar characteristics.
2. Greater freedom from troublesome moding is promised.
3. Higher circuit efficiency for a given external Q is permitted.
4. Easier fabrication is permitted, resulting in greater uniformity from tube to tube.

In deciding on the number of vanes to use in the anode structure, a balance must be achieved between weight as influenced mainly by magnetic field requirements and cathode size as limited by the allowable heater power. It was desired to avoid using too many vanes for several reasons. As the number of vanes is increased, the Q factors are lowered unnecessarily as a result of greater surface area per unit energy stored. The lower limit of vane thickness that it is possible or desirable to fabricate has to be considered, since the anode diameter has to be divided between slot thickness and vane thickness. Increasing the number of vanes means increasing dimensions and decreasing magnetic field strength. Although this leads to a reduction in the magnetomotive force required, a more extended uniform field is necessary. Perhaps the controlling factor in the decision to use an 18 vane anode rather than one having a larger number was the fact that an increase in cathode size above a certain maximum would have required excessive heater power.

Anode Vanes

With the rising sun anode chosen to have 18 vanes the conventional scaling procedures are applied, using as a starting point other successful tubes. Operation in the π-mode where $n=(N/2)$ is, of course, desired. Slater

Table I. Typical Characteristics of PAX3 Magnetrons

Data taken at the minimum required power output value of 50 watts peak

Magnetron No.	Peak Anode Current (Amp.)	Peak Anode Voltage (Volts)	Peak Power Input (Watts)	Efficiency %	i-f Amp	Pulling Figure MC	Frequency Stability MC
37	.2	950	190	26	.295	6	5.3
38	.25	950	238	21	.293	6	4.4
40	.25	820	205	24	.295	7.9	5.3
43	.19	1000	190	26	.290	6	5.9
44	.19	780	148	34	.295	6+	2.7
45	.31	810	250	20	.293	6	2.7
46	.27	870	235	21	.295	6.6	4.4
47	.20	750	150	33	.290	7.2	5.3
48	.12	1000	120	41	.290	7.2	4.7
49	.20	760	152	33	.290	6	5.9
50	.32	780	250	20	.293	6	5.9
51	.31	760	236	21	.290	6	2.9

Magnetron Development

PART ONE OF TWO PARTS

to 9320 MC, and have peak a ±40° C temperature range

has shown that the best ratio of cathode diameter (D_c) to anode diameter (D_a) is given by the equation:

$$s = \frac{D_c}{D_a} = \frac{n-2}{n+2} \quad \ldots\ldots\ldots (1)$$

It has been found experimentally by the Columbia University Radiation Laboratory that for 18 vane rising sun tubes the best compromise between efficiency and stability is given by:

$$s = 0.94\,\frac{(n-2)}{(n+2)} \quad \ldots\ldots\ldots (1_a)$$

with N = 18 n = 9 and

$$s = 0.94\,\frac{(9-2)}{(9+2)} = 0.6 \quad \ldots\ldots\ldots (1_b)$$

Slater has derived from Hartree's equations a set of equations very useful in scaling.[1,2]

$$V_o = 2.52 \times 10^6 \left(\frac{D_a}{n\lambda}\right)^2 \text{ volts} \quad \ldots\ldots\ldots (2)$$

$$H_o = \frac{21{,}400}{(1-s^2)n\lambda} \text{ gauss} \quad \ldots\ldots\ldots (3)$$

$$I_o = \frac{5.23\times10^5}{(1-s^2)2(\frac{1}{2}+1)}\, a_1 \left(\frac{D_a}{n\lambda}\right)^3 \frac{h}{a} \text{ amp.} \quad \ldots\ldots\ldots (4)$$

A_1 (constant for a given design) = to 1 for the range of s used here.

Reduced Variables

These quantities are used as the basis of a set of reduced variables in terms of which two properly operating magnetrons of different wave length and operating voltage range have essentially the same performance chart. Hartree's equation using the reduced variables V/V_o and H/H_o becomes:

$$\frac{V}{V_o} = \frac{2H}{H_o} - 1 \quad \ldots\ldots\ldots (5)$$

Now given N=18, n=9, λ=3.22 cm., V=800 v. and s=0.6 from Equation (1b), we can proceed. Substituting in Equation (3) we have:—

$$H_o = \frac{21400}{9(3.22)\,(1-.36)} = 1154 \text{ gauss} \quad \ldots\ldots\ldots (6)$$

For most efficient operation it is desirable that H, the operating magnetic field, be at least $2H_o$, but not in the region of the so-called efficiency "valley of shadows," which occurs in the rising sun magnetron as a result of zero mode r-f field contamination at the approximate cyclotron frequency given for a cylindrical tube as $H=\frac{12{,}500}{\lambda}$, which for this case occurs at about 3900 gauss. It is desirable to operate either above or below this field strength; efficiency increasing, of course, with increasing magnetic field. Since weight is of prime importance and the magnet weight will rise rapidly with increasing field strength, it was decided to operate below the "valley of shadows," $H = 3H_o$ was chosen as a good compromise between efficiency and weight, thus resulting in a field strength of 3400 gauss. Now from Equation (5) using:

$$\frac{V}{V_o} = \frac{2H}{H_o} - 1 = 2(3) - 5 = 5 \quad \ldots\ldots\ldots (7)$$

and given V = 800 volts, V_o = 800/5 = 160 volts

From Equation (2)

$$D_a = n\lambda\sqrt{\frac{V_o}{2.52\times10^6}}\,\frac{1}{2.54} \text{ in.} \quad \ldots\ldots\ldots (8)$$

$$D_a = \frac{9(3.22)}{2.54}\sqrt{\frac{160}{2.52}} \times 10^{-3} \quad \ldots\ldots\ldots (8_a)$$

D_a = .0906 in.

and since s = 0.6

$D_c = sD_a = 0.6\ (.0906) = .054$ in.

D_a = .0906 inches.

The vane thickness is not critical, except insofar as there is a lower limit of vane thickness which it is possible to fabricate, and since the anode diameter is .0906 with 18 vanes, we have .016 in. per cut section, which is divided equally between vane and slot thickness, thus giving .008 in. This equal division was made to facilitate fabrication of the anode which was done by the hobbing technique. A photograph of this cavity is shown in Fig. 1b.

The next step is to design the anode cavities, which is most accurately done by comparing the so-called "Westinghouse number" of the large cavity and the small cavity. This number is the perimeter of cavity, and has proven to be a good empirical design factor; that is, k(W+w) = wave length, where k is a correction factor most easily evaluated by comparing the Westinghouse number of an operating tube near the same wave length. In this case the basis of comparison was a Columbia Radiation

(*Continued on page* 84)

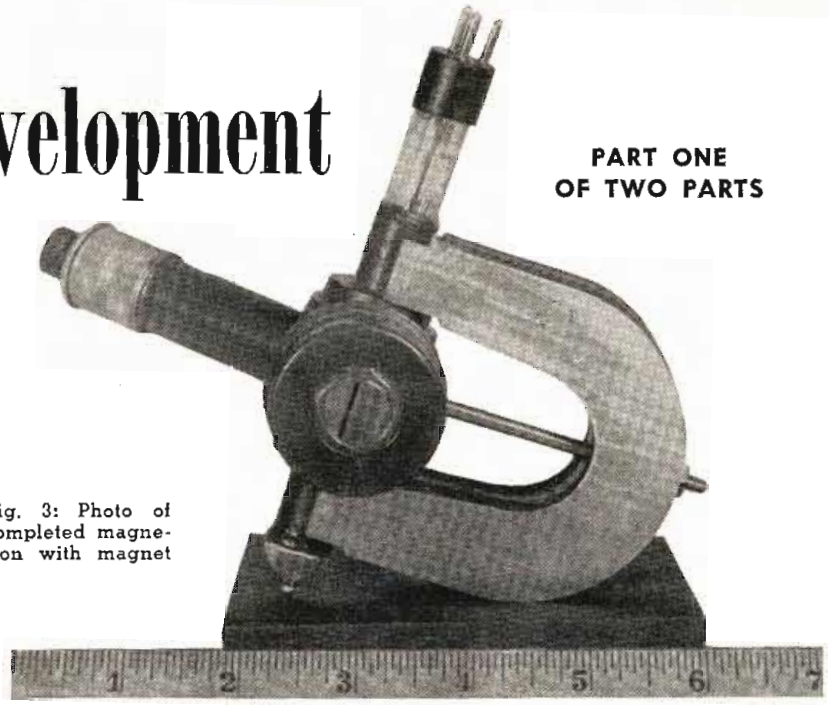
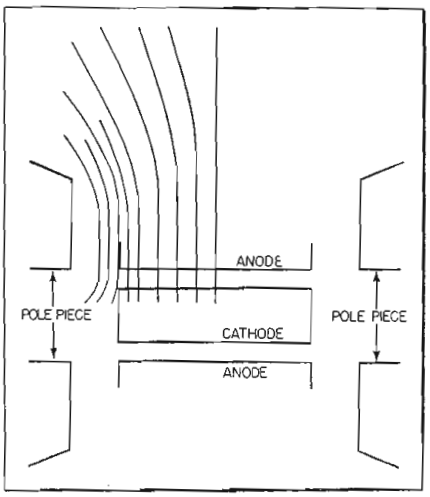


Fig. 3: Photo of completed magnetron with magnet

Definition of Symbols

A —Cathode emitting area
D_m—Small cavity diameter
D_M—Large cavity diameter
h —Anode height
J —Cathode emission density
n —Mode number
N —Number of cavities
η_i —Overall efficiency

Fig. 2: Diagram of equipotential field plot between pole pieces as obtained from an electrolytic field mapping wedge tank



How to Tool-Up for TMs

A guide for manufacturers to help them over rough spots in preparing Technical Manuals for Air Force, Navy, Signal Corps

By LT. COL. STANLEY GERSTIN, Manager, Government Manuals Division, Caldwell-Clements, Inc., New York City

THE accompanying check list and processing flow chart on this and the opposite page are designed to provide manufacturers with a quick check of the primary steps to be followed in preparing a manual, as well as to show the flow of manuscript from a manufacturer responsible for preparing the manual, to the Army, Navy or Air Force publication reviewing agency.

Each Military Service publishes handbook specifications, setting forth its own specific requirements. In the case of the Navy, 16B16 is a basic format specification used by the Bureau of Ships and to a lesser extent by the Bureau of Aeronautics and Bureau of Ordnance. Each of these Navy departments has its own specific requirements, and manufacturers must be sure to get the correct specification called for in the contract.

The Air Force uses specifications some of which are also used jointly by the Navy and Signal Corps. MIL-H-5474A is a common format specification.

The Signal Corps has its own extensive list of specifications for instruction manuals and lists of parts, such as 71-5221-A and MIL-7-10186.

Generally, the Signal Corps requires only manuscript and finished art; the Navy requires printed manuals or reproduction pages and art ready for offset reproduction; the Air Force requires reproduction pages with art ready for offset.

One of the most important points manufacturers should bear in mind is that it is highly desirable to sit down with the publication agency of the Military Service issuing the contract and discuss various requirements of the manual specifications before any work whatsoever is started on preparation of the manual.

Preparation of instruction handbooks and illustrations is a complicated and expensive operation. Organizations specializing in preparation of instruction books, as well as instruction book departments within a manufacturer's plant are trained and experienced to cope with the complicated problem of preparing and processing handbooks. Manufacturers who do not have such a setup should carefully study and acquaint themselves with the many problems involved before setting up such an operation. The check list and the flow chart will help them to obtain a realistic idea of the problems and processes involved and thereby help avoid possible expensive errors.

PREPARATION CHECK LIST

AF-N-SC	1.	Manufacturer is awarded contract for equipment and manual.
AF-N-SC	2.	Obtain and study handbook specifications identified in contract.
AF-N-SC	3.	Discuss details of specification requirements for manual and parts list with the appropriate publication reviewing agency.
AF-N-SC	4.	Engineering department confers with the military to determine extent of field maintenance of equipment and the consequent list of replaceable parts. Information is essential for parts list.
AF-N-SC	5.	Determine extent of depot or fixed installation maintenance or replacement requirements for components.
AF-N-SC	6.	Schedule preparation of manuscript, photography and drawings in accordance with production and delivery schedule of equipment.
AF-N-SC	7.	Assign project to a responsible supervisor.
AF-N-SC	8.	Assign writers, draftsmen, etc., on schedules to conform with requirements in No. 6 above.
AF-N-SC	9.	Prepare first draft of manuscript developed according to applicable technical specifications and appropriate style guide.
AF-N-SC	10.	Prepare drawings, schematics and photographs in accordance with the applicable manual specification and style guide.
AF-N-SC	11.	Submit first draft of manuscript for preliminary review by reviewing agency. First draft to be submitted in multiple copies as required in the applicable specification.
AF-N-SC	12.	Submit copies or photastats of art for preliminary review.
AF-N-SC	13.	Manuscript and art is returned ta contractar for correction after discussion of changes required by reviewing agency.
AF-N-SC	14.	Submit corrected manuscript to reviewing agency, if necessary.
AF-N	15.	Manuscript and art are prepared as reproduction pages ready for offset reproduction.
SC	16.	Submit final copies of manuscript, also original art and photo copies of art as specified in applicable specifications.
	17.	Prepare parts list with exploded views in accordance with applicable specifications to—
N-SC		(a) Accompany manual,
AF		(b) For publication as a separate catalog.
AF-SC	18.	Submit draft of parts list and illustrations in multiple copies as required by the applicable specification for review by the appropriate publication agency.
AF-SC	19.	Correct tabular list of parts and art as required.
AF-N	20.	Prepare reproduction pages, parts list and art as specified.
N-SC	21.	Produce by letterpress or offset the manuscript, art and parts list.
SC	22.	Prepare manufacturer's drawing as required.
SC	23.	Prepare service drawings as required by applicable specifications.
AF-N-SC	24.	Transmit all material (manuscript, art, parts lists, reproduction pages, etc.) to appropriate reviewing agencies through inspection officers at the plant, if any, or directly to the district offices or designated publication agency as required.

Legend: AF: Air Force N: Navy SC: Signal Corps

GUIDE TO MILITARY HANDBOOK PROCESSING

Review Procedure for Preparation of Original Manuscript, Art and Parts Lists and for Production of Printed Copies of Manuals on Radio, Radar, Electronic Equipment for Navy, Air Force and Signal Corps

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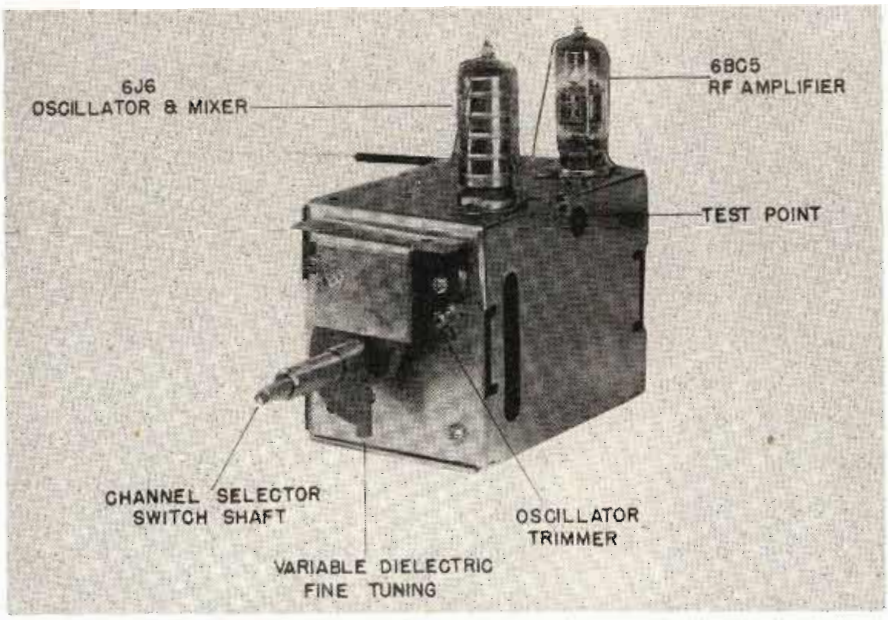
Two-Tube TV Tuner Design

PART TWO
OF TWO PARTS



Front view of tuner showing the locations of test point and oscillator trimmer

By CHARLES S. ROOT, Television Engineering Dept., The Magnavox Co., Fort Wayne 4, Ind.

THE oscillator circuit used is the conventional grounded cathode Colpitts with the inductance connected from grid to plate. It will be seen that series coil switching is also used for the oscillator, using wafer section 1. The elimination of individual channel oscillator adjustments makes this practicable. If each coil had to be made available for individual front panel adjustment, series coil switching could not be used without having to realign all lower frequency coils each time any one coil was readjusted. In addition to the advantage of being able to mount all coils directly on the switch lugs, the series coil arrangement has the further advantage, in the oscillator case, of greater oscillator stability due to not having to connect any switching elements to one end of the coil string (in this case, the grid end).

The same difficulty of obtaining large enough loop coils on the high channels was experienced with the oscillator circuit. The solution here was to make the tube coupling capacitor C18 as small as practicable and still have adequate oscillator strength, and then to provide a gap in the front rotor blade, so that the rotor blade inductance becomes less with each step of switching from channel 13 down, thus allowing considerably more inductance in the loop coils. (This could not be done in the mixer grid case because the resulting increased rotor inductance on channel 13 did not allow a sufficiently large channel 13 coil G13 for an adequately wide range of channel 13 adjustment.)

Fine Tuner Range

As previously mentioned, it was necessary to have a relatively wide fine tuner range in order to safely eliminate the individual channel front panel adjustments. In order to obtain this with the dielectric type fine tuner, the dielectric cam was made as thick as it could be and still be a low cost punched part. It was then necessary to connect the fine tuner (C19) into the oscillator circuit in such a manner as to effect the widest possible frequency change obtainable with a given variable capacity with one side grounded. This was done by connecting the fine tuner (C19) to the oscillator plate (rather than to the grid which has higher tube capacity to ground) and by connecting all other necessary capacities (the trimmer capacitor C17, the oscillator injection capacitor C12, and the temperature compensating capacitor C16) all to the grid. This provides a maximum capacity from grid to ground and a minimum capacity from plate to ground so that a given change in the plate to ground capacity by the fine tuner will produce a bigger frequency change. The tuning range obtained was about 4 MC on channel 13 and 2 MC on channel 2. The oscillator warm-up drift obtained by the use of the proper temperature conmpensating capacitor C16 is shown in Fig. 3 for channel 13, the channel subject to the greatest drift.

Reduced Loading

In order to achieve substantially the same r-f selectivity, sensitivity and signal-to-noise ratios on the high band channels as on the low band, as shown in the performance table of Fig. 1, the tendency toward greater tube loading on the high channels must be overcome. R-F amplifier input loading on the high band is countered by r-f screen regeneration introduced by the use of longer than usual leads on the screen by-pass condenser (indicated by the L5, C4, L6 combination shown on the schematic), as well as by the use of a relatively large grid resistor R1 (22,000 ohms) to minimize grid resistor loading on the high band. Loading is also reduced by the tapping down of the tube input on the tuned circuit by means of capacitor C1.

Mixer input loading on the high band is reduced by using relatively high oscillator injection which means that the converter gain is derived more from the strong oscillator signal and less from the amplification of the mixer tube. (Less tube amplification means less tube input loading.) The remaining mixer loading is countered by the elimination of any shunt feed resistors in the r-f plate circuit and mixer grid circuit, thus allowing the full coil Q's to be effective. This is done by feeding the r-f plate current through the plate coil string and by placing the mixer grid leak resistors R6 and R16 and by-pass condenser C11 in the ground return of the mixer coil string so that the re-

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sistors do not connect across the coil string as they would for shunt grid feed.

On the low band it is necessary to use relatively low Q tuned circuits in order to obtain the proper bandwidth. This could be done by using very fine wire coils but these would be physically unstable against jars and vibrations. It is, therefore, more practicable to use coils of the necessary size wire for mechanical stability and then load the circuits with

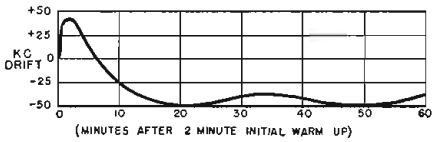


Fig. 3: Oscillator warm-up drift curve

suitable resistors to obtain the necessary low Q. This is done by the resistors R13 and R5 on the r-f grid and plate wafers, respectively.

Use of a triode mixer is advantageous both because of its lower noise and also the fact that a double triode may be used for mixer and oscillator, thus reducing the tube total to two. However, due to the large grid to plate capacity, there are various oscillator feed-through effects and i-f and r-f feedback effects to which very careful attention must be given for optimum results.

There will be a large oscillator voltage fed through from the mixer grid to mixer plate which must be prevented from appearing on the first i-f grid where it would be rectified and result in a large negative bias on the i-f tube, thus reducing gain very substantially and would also induce oscillator voltage into the main TV chassis with resultant greater oscillator radiation, especially on the high channels. This is eliminated by connecting the mixer coil L4 in series between the converter plate and first i-f grid so that it is tuned by the mixer plate capacity and the first i-f grid capacity in series. At the oscillator frequencies, the mixer i-f coil then appears merely as a choke to prevent oscillator voltage on the converter plate from getting to the first i-f grid. This arrangement does not result in any loss in gain because the i-f coil inductance becomes considerably larger since it is tuned by the mixer output and first i-f input capacities in series instead of in shunt.

The triode mixer also has relatively low plate resistance compared to a pentode so that it furnishes a large portion of the damping needed for proper bandwidth in the mixer plate —i-f grid circuit. In order to avoid adding unwanted additional damping by the mixer plate B+ feed resistor R12, that resistor is connected to a tap near the center of the mixer plate i-f coil at a point on the coil which is at i-f ground potential, said point being determined by the relative capacity of the mixer output and i-f input capacities.

I-F degenerative feedback occurs in the mixer if too small a grid blocking capacitor C11 is used, as discussed before. R-F regeneration will occur on the low channels due to the tuning of the grid circuit getting close to the i-f frequency. This becomes a maximum on channel 2 where, although the grid r-f frequency is still more than twice the plate i-f frequency, there is considerable feedback because of the relatively large grid to plate capacity compared to a pentode.

Reducing R-F Regeneration

In order to reduce the r-f regeneration on channel 2 to an acceptable level, the 10 mmf capacitor C21 was added from mixer plate to ground. This reduces the portion of the i-f voltage across L4 that appears across the mixer output. It might be expected that the addition of such a capacitor would considerably reduce the conversion gain. Actually, there is only a small gain reduction because the Q of the i-f circuit is considerably increased. This occurs because the larger effective mixer output capacity (compared to the i-f input capacity) means that the mixer plate resistance is across less of the tuned circuit. The higher Q provides more nearly the desired i-f selectivity characteristic than would otherwise be obtained. Also the variation in that selectivity characteristic due to varying mixer plate resistance with different tubes (and from channel to channel due to varying oscillator injection) is greatly reduced.

There is one other type of r-f regeneration with a triode mixer which must be considered and that is regeneration on the high channels due to resonance of the lead from mixer plate to the i-f coil L4 with a total series capacity consisting of the mixer tube output capacity and the i-f coil distributed capacity to ground. If the lead can be kept short enough and the i-f coil distributed capacity kept small enough, the resonance may occur far enough above

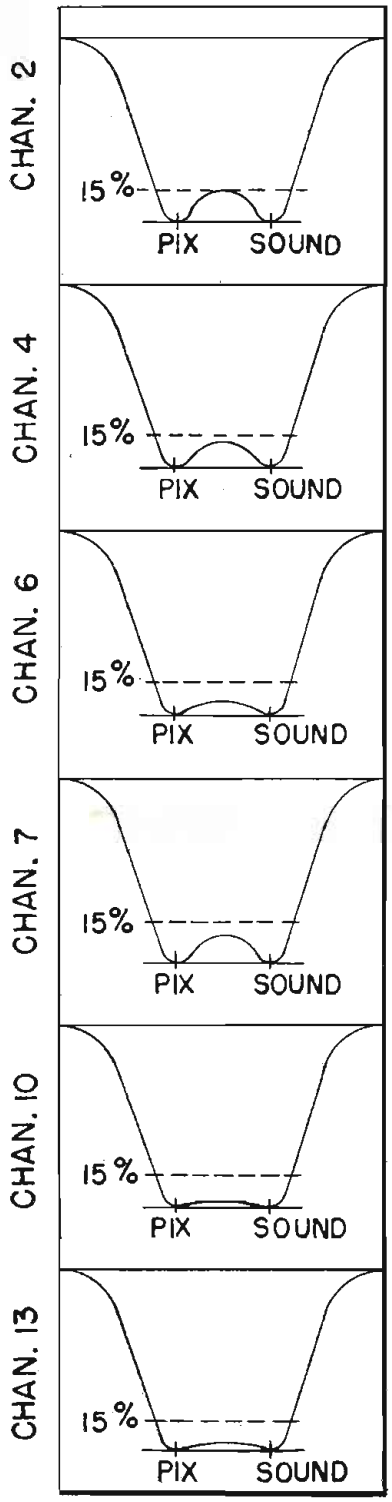


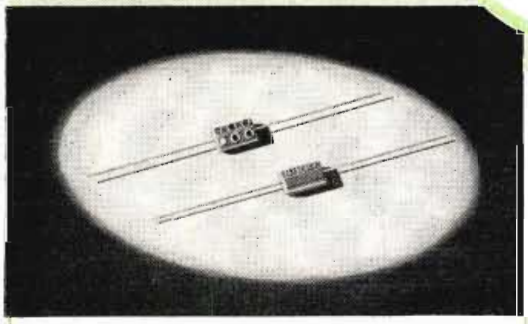
Fig. 4: Tuner r-f curves for six channels

the high band to avoid regeneration. If, however, the 10 mmf capacity C21 is added at the i-f coil, it will effectively increase the i-f coil distributed capacity to ground and thus may cause considerable i-f regeneration in the high channels because of feedback of the mixer plate resonant r-f voltage through the large plate to grid capacity. This arrangement has,

(*Continued on page* 70)

$15,000 A QUART

That's what it cost a prominent watchmaker to develop a type of oil suitable for its precision requirements. (Each worker is given a drop a day with which to oil 500 new watches.)



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WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by TELE-TECH's Washington Bureau

RADIO-TV MANUFACTURING SITUATION RECOGNIZED—The Armed Services and the Defense Mobilization top officialdom have commenced at last to recognize the vital importance of keeping the electronic-radio manufacturing industry "healthy and robust." For only in this way can it be well prepared as a military production machine, in event of all-out war, through the spreading of defense orders and the making available of short-supply materials and metals for civilian products such as television transmitters and receivers and broadcasting apparatus.

MANUFACTURERS PROTEST—The electronic-radio manufacturing industry, even though it has suffered severe inroads of shutdowns of TV receiver production, has made vigorous presentations to the National Production Authority for modification of the restrictions on steel and iron, especially the NPA order limiting use of steel and iron to 50% of the total units assembled during last year's base period.

SHORTAGES OF MATERIALS—The TV-radio tube industry has encountered difficulties in the shortages of nickel and cobalt particularly, and of tungsten and copper. This has produced increased concern for the tube manufacturers in their production of power and transmitting tubes used in radio and television broadcasting, radar, radio communications and in many industrial applications of electronic devices.

NEW TV STATIONS BY MIDDLE OF 1952—The FCC "freeze" on new television station construction permits, which has been in effect since Sept. 30, 1948, will finally be lifted late this year, according to the recent views of FCC Chairman Wayne Coy, and the nation may start having the new video stations on the air by the middle of 1952. The FCC chieftain expects that the Commission will be able to commence the sanctioning of new TV station applications about Dec. 1.

COY ESTIMATES 2000 TRANSMITTERS—Chairman Coy predicted that the FCC's reorganized plan for a national television system would make possible 2000 stations in 1200 communities which would means "interference-free, high-quality television" in virtually every part of the United States. Hearings are to commence before the FCC on June 11 on the city-by-city allocation channels and considerable controversy is expected to develop, especially on the proposal to reserve channels for 200 non-commercial educational TV stations. As of the present, the television manufacturing industry feels it can supply the transmitting equipment in sufficient supply for the new stations and will also be able to produce substantial quantities of UHF video receivers.

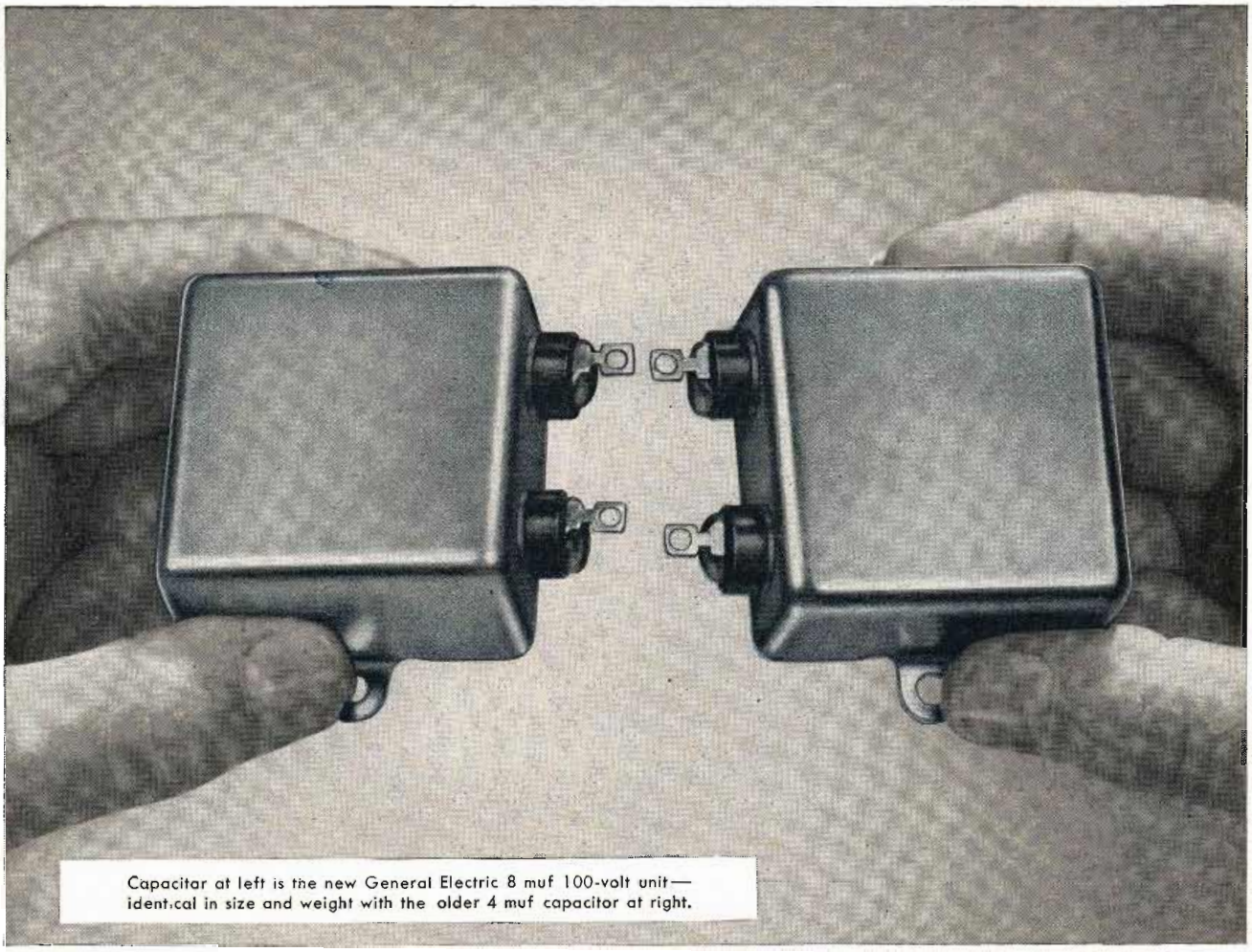
FCC POWER OVER GOVERNMENT ALLOCATIONS—To give greater and deserved power to the governmental authorities charged with implementing spectrum space for the important radio-broadcasting and radio-communications services of the American public, Chairman Ed C. Johnson of the Senate Interstate and Foreign Commerce Committee has sponsored a bill to give the FCC authority to assign frequencies for governmental use. This was a solution, proposed by the veteran Senator whose committee is charged with the formulation of radio legislation, for the troublesome controversy of frequency space of government radio services, including the military, and may result in giving civilian radio, television and communications a "square deal" in the division of the spectrum.

MIGHT OBVIATE THREE-MEMBER BOARD—Since the new FCC bill is propounded by the powerful Senate committee chairman, this method of having the FCC granted the initial responsibility of assigning frequencies may obviate the plan of a permanent three-member board on communications and radio which was recommended by the President's Temporary Communications Policy Board. (Incidentally, the Senator's plan backs strongly the ideas which have been voiced so effectively by TELE-TECH in its editorials.)

SINGLE PRESIDENTIAL ADVISER?—Meanwhile, the executive branch of the government has been drafting a plan to have a single adviser to the President on radio-frequency matters. If this plan is put into effect, there are two leading possibilities for that post—former FCC Commissioner E. K. Jett who is now radio-television general manager of the Baltimore Sunpapers; and Haraden Pratt, former IRE president, vice president and chief engineer of American Cable & Radio Corp. Both men have had wide experience in radio administration and in spectrum allocation, and have the judicial temperament and expert knowledge needed for the difficult task of assuming top responsibility in the settlement of the difficult contentions sure to arise at the White House level.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor



Capacitor at left is the new General Electric 8 muf 100-volt unit—identical in size and weight with the older 4 muf capacitor at right.

8 muf...in the space of 4

New General Electric line of 100-volt d-c capacitors marks another important step in reducing size and weight of electronic equipment.

Here is another outstanding G-E capacitor development—thinner paper, thinner foil, so that double or triple the capacitance can be designed into a cubic inch.

These new capacitors are comparable in all ways with previously offered paper dielectric units, are equally dependable, and in addition are smaller in size and lighter in weight. They will not introduce noises into the system. They will satisfactorily pass signal voltages approaching zero. Their insulation resistance values remain high after long periods of service. While primarily intended for d-c applications with allowable ripple voltages in accordance with JAN-C-25, they will withstand occasional discharges, and can be used in low-voltage a-c circuits.

In Regular Production. Units of 3, 8 and 10 muf in Case Style 53 and 4 muf in Case Style 61 are in regular production. Other ratings can be built in mass-production quantities.

These capacitors meet all requirements of "F" characteristics of JAN-C-25 for 100-volt d-c units. For applications where an expected life of 1000 hours at 40 C is satisfactory, rating can be increased to 150 volts. For ambients above 40 C, units should be derated in accordance with JAN-C-25 Specifications. There is negligible change in capacitance from −40 C to 105 C—and units will give full life at temperatures as low as +55 C.

If you have applications involving reasonable quantities, get in touch with us. Your letter, addressed to Capacitor Sales Division, 42—304, General Electric Company, Pittsfield, Mass. will receive prompt attention.

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GENERAL ELECTRIC

407-305

TELE-TECH's NEWSCAST

Philco and M.I.T. Announce 5-Year Program

A program by which Philco Corp. will join with the Massachusetts Institute of Technology in many fields of scientific research useful both to national defense and to the civilian economy was announced recently by William Balderston, president of Philco.

"The next five years will be a crucial period in the development of electronics, and thus of vital importance in the nation's defense effort as well as our industrial progress," Mr. Balderston stated. "This intensified program of cooperative research, with the scientists and engineers of M.I.T. and Philco working together on key projects, is certain to make many important technical contributions. Our company and the Institute have cooperated for the past 10 years in a program of training engineers, in many forms of electronic development work, and in the exchange of technical information. The new agreement broadens and strengthens this alliance between the personnel of one of the world's foremost scientific institutes and over 1500 Philco research scientists and engineers."

Under the new agreement, M.I.T. and Philco will exchange information on research results in a variety of fields. Military and commercial electronics, television and radio, refrigeration and home appliances are among the subjects of joint interest.

The program also calls for special conferences and seminars, an exchange of visits by M.I.T. and Philco executive and technical personnel, use of scientific libraries, and a joint policy to cover inventions and patents.

Colored Solder

One of the difficulties in mass-produced assembly lines is ensuring that all wiring joints have been soldered, and it is common practice to coat each joint with a colored lacquer on inspection. This method of checking is laborious and in some cases not completely satisfactory. Demonstrated at the recent British Radio Component Show in London, England, was a colored core solder.

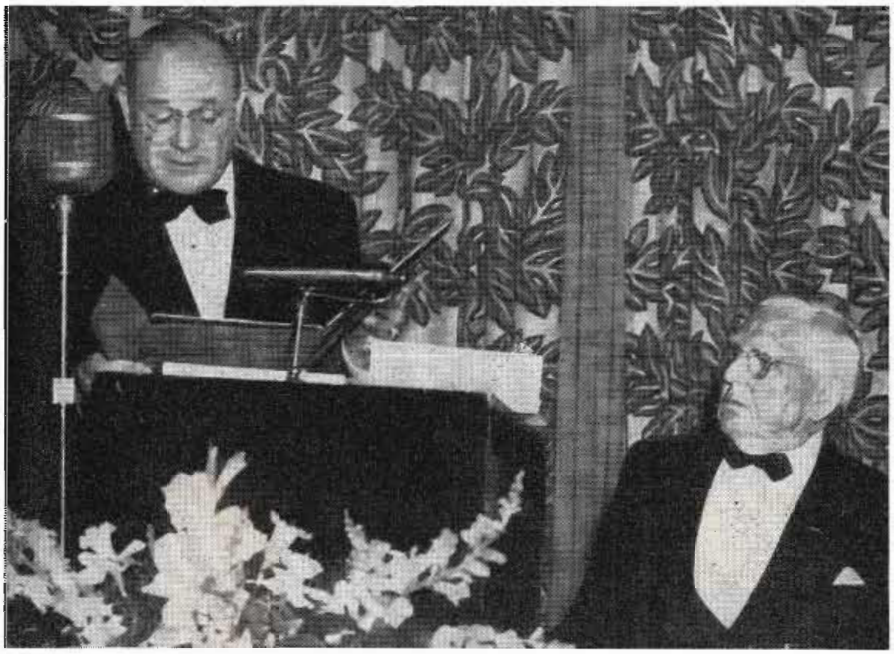
By incorporating a colored flux in the solder it is possible to indicate the finished joint automatically, as the flux runs to the edges and remains as a permanent indicator. Super-speed solder with four different colors of core is now supplied by H. J. Enthoven & Sons and was demonstrated in use. The addition of the coloring matter does not affect the electrical or mechanical properties of the solder.

Cannon Electric Opens New Eastern Plant

Cannon Electric Co. has opened a new plant in the East Haven district of New Haven, Conn. The move brings the total of Cannon Electric plants to four, with two in Los Angeles and one in Toronto, Ontario, Canada. The new plant is located at 191 Kimberly Street, on Highway No. 1, in East Haven.

To head the Engineering Department of the newly created Eastern Division, E. C. Quackenbush, well-known electrical engineer and specialist on "AN" and other types of electrical connectors, has joined the company. Mr. Quackenbush was previously associated with prominent manufacturers of connectors and wiring devices. He is a member of the IRE and the American Society of Metals.

KIMBLE RECEIVES "OUTSTANDING SERVICE" AWARD



Col. E. E. Kimble, right, veteran glassmaker and founder of Kimble Glass (now a division of Owens-Illinois Glass Co.), hears H. B. Richmond, chairman of the awards committee of the Scientific Apparatus Makers Assoc. and board chairman of General Radio Co., read a citation naming him recipient of the SAMA Award for Outstanding Service. Presentation was made at SAMA banquet in White Sulphur Springs, W. Va.

Coming Events

June 11-15—Second Annual Conference on Industrial Research, Columbia University, New York City.

June 18-20—American Society for Testing Materials, Annual Meeting, Atlantic City, N. J.

June 21-22—Ninth Annual Conference on Electron Devices, Sponsored by IRE and AIEE, University of New Hampshire, Durham, N. H.

June 25-29—AIEE Summer General Meeting, Royal York Hotel, Toronto, Canada.

June 28-30—Institute of Navigation, Annual National Meeting, Hotel New Yorker, New York City.

July 4-14—British Instrument Industries' Exhibition, National Hall, Olympia, London, England.

August 15-18—Associated Police Communication Officers, 1951 Conference, Everglades Hotel, Miami, Fla.

August 22-24—7th Annual Pacific Electronic Exhibit, 1951 IRE Western Convention, Civic Auditorium, San Francisco, Calif.

September 10-14—Sixth National Instrument Conference and Exhibit, Sponsored by Instrument Society of America, Sam Houston Coliseum, Houston, Texas.

October 22-24—Seventh National Electronics Conference, Edgewater Beach Hotel, Chicago, Ill.

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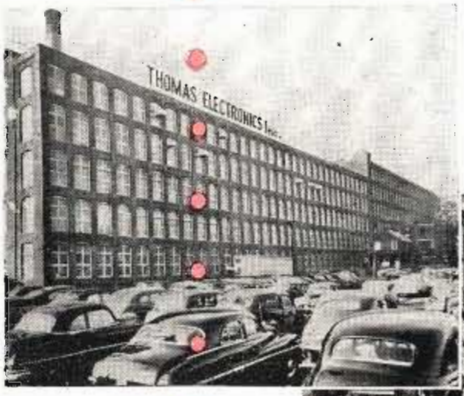

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BURTON BROWNE ADVERTISING

Color TV Transmissions by RCA in New York

The Radio Corporation of America has begun color TV tests from its experimental transmitter in the Empire State Building, New York City. The pictures are visible on NBC's channel 4 and are receivable on standard monochrome television receivers. As a matter of fact many viewers reported that reception was better than usual. This is probably due to the necessity for keeping all transmitting circuits in better alignment when transmitting color TV as well as the crispening effect of the dot interlace effect produced by the color transmission system. The decision of the Supreme Court in the appeal of RCA and others from the FCC's decision to standardize on CBS color is still pending. If the Supreme Court upholds the FCC, the field sequential system will become standard and non-compatible, and the RCA compatible and dot sequential system will be relegated to experimental use only.

The current RCA color transmissions are radiated by KE2XVJ which is the experimental transmitter of the National Broadcasting Co. in New York City. Since these tests are unscheduled and of an experimental nature, no information is available concerning the length of time that they will be available.

East to West Microwave Relay Completed

The 107th microwave relay unit in the cross-country chain was completed recently when the construction crew met at a point northwest of Denver, Colo. It is expected that equipment for handling telephone conversations will be completely installed by the end of August, and that by the end of the year, if required, the television relaying apparatus will be ready to carry Milton Berle from coast to coast.

Initially more than 100 through-telephone circuits will be provided between Chicago and San Francisco as well as several short-haul circuits between cities *en route*. To avoid reflections from the huge expanse of the salt flats around Salt Lake City the route had to follow a horizontal "W" path. Interconnection with the San Francisco-Los Angeles relay occurs just outside San Francisco at East Bay Hills.

New Television Tube

U. A. Sanabria has announced the production of a new type of TV tube for home receivers. The president of American Television Inc., Chicago, Ill., reports that the new tube which combines magnetic and electrostatic focussing will save as much as $2.50 per tube in production costs. Among the features are constant focus, obtained by a new type of electron gun, and improved picture contrast. The new tube is known as an "Image-orthoscope."

Home entertainment has changed

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Capacitors • Trimmers • Choke Coils • Wire Wound Resistors

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Now, though **HI-Q** output has reached several million capacitors, trimmers, choke coils and wire wound resistors each month, never once have the original precision standards or strict adherence to specifications and tolerances been shaded — or the rigid system of inspection of each individual unit at each stage of production been relaxed. The **HI-Q** engineering staff is just as ready as ever to cooperate with your engineers in the production of special components for special requirements.

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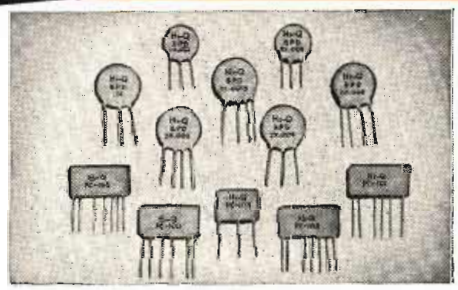

HI-Q DISKS AND PLATES

High dielectrie by-pass, blocking or coupling capacitors for use where their geometrical shape makes them more adaptable than tubular components. Essentially similar, other than shape, except that in multiple units, **HI-Q** Plates do NOT bave to have a common ground, as is the ease with the Disk type.

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- ✓ UNIFORMITY
- ✓ DEPENDABILITY
- ✓ MINIATURIZATION

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TYPE	DIALS	OHM STEPS	TOTAL RESISTANCE—OHMS
542	1	0.01	0.1
543	1	0.1	1
544	1	1	10
545	1	10	100
546	1	100	1,000
547	1	1,000	10,000
548	1	10,000	100,000
549	1	100,000	1,000,000
550	1	1,000,000	10,000,000
840	2	0.1	11
841	2	1	110
842	2	10	1,100
843	2	100	11,000
844	2	1,000	110,000
817	3	0.01	11.1
818	3	0.1	111
820	3	1	1,110
821	3	10	11,100
822	3	100	111,000
823	3	1,000	1,110,000
824	3	10,000	11,100,000
817-A	4	0.01	111.1
819	4	0.1	1,111
825	4	1	11,110
826	4	10	111,100
827	4	100	1,111,000
828	4	1,000	11,110,000
817-B	5	0.01	1,111.1
8285	5	0.1	11,111
829	5	1	111,110
830	5	10	1,111,100
831	5	100	11,111,000
817-C	6	0.01	11,111.1
8315	6	0.1	111,111
832	6	1	1,111,110
833	6	10	11,111,100

Accuracy

Adjustment of individual resistors is as follows:

0.01 ohm 5%
0.1 ohm 1%
1.0 ohm 0.25%
All others 0.1%

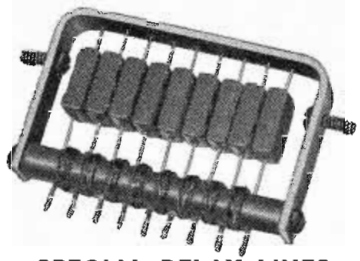
Closer tolerances available on request

Write for Shallcross Engineering Data Bulletin L-17

SHALLCROSS MANUFACTURING COMPANY
Collingdale, Pa.

Precision Resistors • D-C Bridges • Low Resistance Test Sets • High-voltage measuring equipment • Galvanometers • Rotary Selector Switches • Attenuators Capacitor Analyzers • Transmission Test Sets . . . and custom-built electronic specialties

Something New



SPECIAL DELAY LINES

Lumped delay lines "tailored" to specific applications have been announced by the Shallcross Manufacturing Co., Collingdale, Pa. A typical unit consists of eight pie-section low-loss filters having a rise time of 0.04 microseconds and a total delay of 0.3 microseconds. Maximum pulse voltage is ± 100 volts and impedance is 500 ohms. Cutoff frequency is 8.5 megacycles and the maximum operating frequency approximately 2 megacycles based on a pulse delay error of not more than 2%. The unit consists of eight universally-wound coils of 3-strand #41 Litz wire and nine low T.C. silver mica capacitors. Many other types can be supplied.

NEW SHALLCROSS WHEATSTONE-MEGOHM BRIDGE

The new Shallcross 635-A Wheatstone-Megohm Bridge is a versatile direct-reading instrument for accurate measurements between 10 ohms and 1,000,000 megohms. It can be used to measure resistance elements and insulation resistance and to determine volume resistivity of materials. The instrument is basically a Wheatstone Bridge used in conjunction with a d-c amplifier. Two built-in power supplies operating on 115 volts, 60-cycles automatically provide the correct bridge voltages for the high and low ranges. Full information is available from the Shallcross Manufacturing Co., Collingdale, Pa.

METAL-ENCASED RESISTORS

Flat, metal-encased, Type 265-A wirewound power resistors introduced by the Shallcross Manufacturing Company, Collingdale, Pa. are space-wound, have mica insulation, and are encased in aluminum. At 175°C. continuous use they are conservatively rated for 7½ watts in still air and 15 watts mounted flat on a metal chassis. Write for Bulletin 122. *Adv.*

A Masterpiece

COMPLEX, EFFICIENT . . . KESTER SOLDER MAKES IT POSSIBLE

Good fast work can only be done with the best materials. Kester Plastic Resin-Core Solder and the more active Kester "Resin-Five" Core Solder, made only from the finest grades of tin and lead commercially available, are formulated especially for TV, radio, and electrical work. Kester Solders flow better . . . handle easier . . . faster to use. These two Solders, which are available in the usual single-core type, can now also be had in a 3-core form.

KESTER SOLDER COMPANY
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KESTER SOLDER

Television Films

(*Continued from page* 39)

stalled in the master camera.

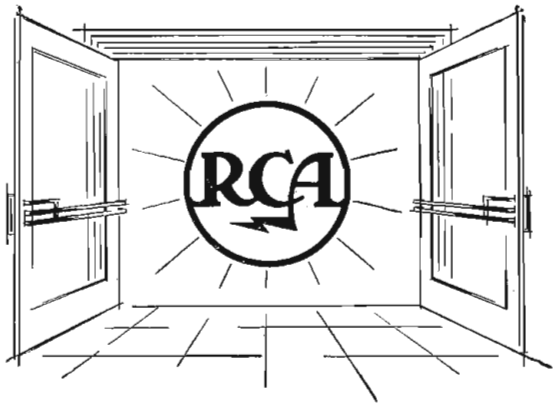
Connected to the same circuit as the marker bulbs and mounted on the top of the slave camera is a red telltale. When action switches to the slave, this telltale is illuminated to show which camera should be played to, and coincidentally the marker light in each camera commences marking the film. On the master camera, the red telltale is extinguished when the slave light comes on, and vice versa.

When the master camera only is in use, the appropriate telltale is lit, and during the time that the slave is coming up to speed, a green light burns in addition on the top of the slave camera. This is extinguished when the slave marker and telltale are illuminated. When the particular sequence calling for a shot from the slave is ended, the producer—or cameraman — moves his control switch to "off" position and the two marker lights are extinguished as well as all telltales except the red one of the master camera.

After filming is completed, there will be two films. That from the master camera has a continuous sound record on it in addition to pictures and the one from the slave which has intermittent sound and picture sequences which occurred when the producer's script called for specific shots. Each film bears a series of index marks on the perforation side, indicating points at which the slave camera has come up to speed and taken the action. These index marks continue as long as the slave is in operation.

On completion of filming and processing, all that the editor does is match up the marks on the master and slave films. Wherever there is a mark on the master, there will be a mark on the slave; and each one is marked for exactly the same length of time. Thus, the two clips can be exchanged, and since the slave also carries a sound track which exactly matches the discarded sound track and film length from the master print, its insertion provides a different shot, with the same correct sound.

With the average rapid service available in most cities, of about two hours on reversal film, it is possible that within less than three hours after shooting with two cameras, a completely edited and sound synchronized film will be available. The editing process consists only of cutting and splicing at the marks, and by running the two films through the



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RADIO CORPORATION of AMERICA

(Continued from preceding page)

editor with a synchronizer an extremely rapid job can be done in one passage through the equipment.

In the second system the master camera records single system sound throughout the production, and the slave is silent. In this case it is often possible to use a fine grain sound emulsion in the master camera since its shots may be restricted to constant high level illumination shots which are not affected by the lower speed of the sound emulsion. The film produced in the slave consists of silent sequences, each of which bears an index mark corresponding to an equal length of similarly marked film in the master sound camera.

After processing, a protection print is made of the sound track, and the master and slave films are interspliced at the index marks according to the script. The protection track is then printed together with the mute combination of master and slave films. Since the length of the portions cut out of the master (which carried the sound track) is exactly replaced by the slave clips, exact sound synchronization is achieved in a much shorter time than would be the case if straight double system sound recording were used. The composite film thus obtained is then used for printing or final use if only one print is required.

Audio

One Auricon amplifier provides sufficient drive for the two recording galvanometers with the addition of a matching transformer. The dc supply to the recording lamps requires modification since placing the two lamps in parallel would result in overloading the indicating ammeter. To provide accurate indications a 5 ohm variable resistor was connected across the meter. With one lamp connected the voltage is adjusted in the usual manner. The adjustable shunt is then set for half scale reading; connection of the second recorder lamp should bring the reading back to the original.

If only one recorder is used the shunt can be disconnected so that an accurate full scale reading is obtained. For most single system work Kinolux film type TV is used. This has a long contrast range and fine grain which produces very acceptable television pictures. For this emulsion a reading of 17.5 on the recorder meter gives excellent sound reproduction. When operating as a double system installation Kinolux #1 film

TONE ARMS-STYLI

...still available
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MANUFACTURERS: Your production requirements of General Electric phono-accessories can still be filled. General Electric application engineers have suggestions that will help you design a better product. Call or wire us today for details. *General Electric Company, Parts Section, Electronics Park, Syracuse, New York.*

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GENERAL ELECTRIC

(*Continued from preceding page*)

is used for sound recording.

There is no automatic device to indicate when the slave camera is up to speed, nor is there provision for previewing as there is in some systems. It is not felt that this extra complication is necessary, since the time required to come up to speed is only a few seconds, and by watching his script the producer can be prepared in time to switch to "standby" a few seconds before the cut is made to the slave. A point to watch in cutting film is to be sure to cut on the waste side of the sync mark when normal lap splices are used, otherwise there is a risk of spoiling synchronization for twenty-six frames at each splice.

Further refinements suggest themselves; for instance, by attaching Selsyn drives to iris faders on each camera it is possible to make fades in and out and still retain properly synchronized sound. This avoids the need to use an optical printer with its extra cost.

[1] "Movies for TV", by John H. Battison. Published 1950 by Macmillan Co., 60 Fifth Ave., New York City.

Two Tube Tuner

(*Continued from page* 56)

in fact, been used by many tuner designers in order to provide regeneration to overcome mixer grid loading on the high channels. In the tuner being described, however, it was felt that the use of both mixer regeneration and r-f screen regeneration on the high channels was dangerous and that, of the two, it was better to use the r-f screen regeneration where the increased amplifier gain on the high channels would pay off in a lower noise figure. Accordingly, the 10 mmf capacitor C21 was located at the mixer tube socket so that only the lead inductance inside the tube is resonated by it in series with the mixer output capacity and thus the resonance definitely occurred considerably above the high channels, and high channel mixer regeneration was avoided.

In summary, the capacitor C21 has 3 desirable effects. It minimizes low channel and high channel r-f regeneration and provides the necessary higher and less variable Q for the i-f circuit.

Another version of the tuner, using a 12AT7 double triode instead of the 6J6 is also in production for use especially in split sound receivers where less oscillator microphonism can be tolerated. The performance is essentially the same as for the 6J6 version described herein and the circuit is likewise almost identical except for minor variations.

Another RCA FIRST!

The new RCA 21" metal rectangular kinescope featuring electrostatic focus

Now . . . RCA electrostatic focusing in a super-large 21" kinescope . . . combining all the advantages of this new RCA technical achievement with the superior constructional features of metal-shell picture tubes. The tube provides television pictures of equal or better quality than magnetically focused types and is a lasting, long-range engineering accomplishment which goes beyond the present program to conserve critical materials.

The new RCA-21DP4 has a maximum over-all length of only 22⅝", and a picture area of 18⅜" x 13 1/16". The frosted Filterglass face is made of high-quality glass, provides improved contrast, and minimizes specular reflection. Since the tube utilizes the structural strength of steel, and weighs substantially less than a comparable all-glass tube, it can be safely shipped in the receiver.

The RCA-21DP4 employs an electron gun of improved design that provides good uniformity of focus over the entire picture area. Focus can be maintained automatically with variation in line voltage and with adjustment of picture brightness. Because the focusing electrode draws very little current, the voltage for the focusing electrode can be provided easily and economically. Design-center maximum voltage rating is 18 kilovolts, diagonal-deflection angle 70°, and horizontal-deflection angle 66°.

RCA Application Engineers are ready to consult with you on the application of the RCA-21DP4 and its associated components to your specific designs. For further information, write RCA, Commercial Engineering, Section 57FR, Harrison, N. J., or your nearest RCA field office.

FIELD OFFICES: (EAST) Harrison 6-8000, 415 S. 5th St., Harrison, N. J. (MIDWEST) Whitehall 4-2900, 589 E. Illinois St., Chicago, Ill. (WEST) Trinity 5641, 420 S. San Pedro St., Los Angeles, California.

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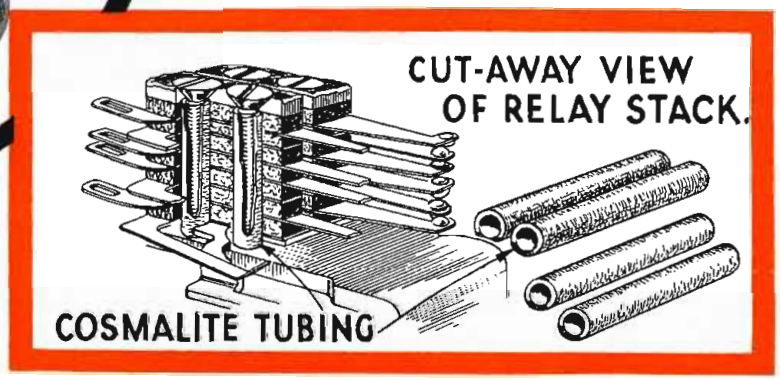

Their S K Relay shown above, is typical of the various Allied Relays in which CLEVELAND CONTAINER tubing provides excellent service.

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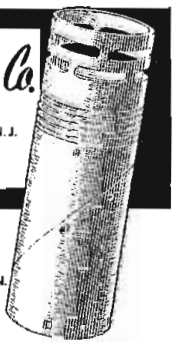

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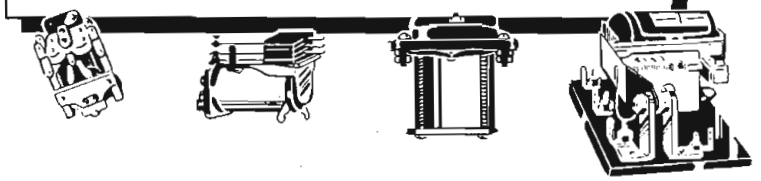

Whether you require large quantities of relays for production runs or single units for laboratory or amateur work, Wells can make immediate delivery and save you a substantial part of the cost.

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Each relay is brand new, standard make, inspected, individually boxed and fully guaranteed.

The following list represents only a tiny portion of our relay stock. Write or wire us for information on types not shown.

KEYING RELAYS

Stk. No.	Voltage	Ohmage	Contacts	Unit Price
R-714	9/14	65	2C/5 Amps	$1.55
R-653	12	14	2C	1.55
R-721	18/21	290	2C/5 Amps	1.55
R-773	24	280	3C/10 Amps	1.60
R-694	24	300	1A/5 Amps	1.50
R-704	2/6	.25	2B/5 Amps	1.35
R-297	115*	...	2C	2.80
R-173	2/6	2	1A	1.55
R-280	6/8	77	1A DB	2.45
R-647	6/12	15	1B/20 Amps	1.45
R-273	20	160	2A/15 Amps DB	3.55
R-169	24	200	1A	2.45
R-570	24	230	1B DB	2.70
R-171	24	230	2C/10 Amps	2.70
R-329	24/48	1020	2C	3.10
R-715	24*	...	2C Ceramic	3.70
R-584	6	20	1A DB	1.30
R-192	12	44	3C/10 Amps	1.70
R-204	12	66	2A	1.45
R-224	12	85	1A	1.45
R-221	18/24	5000	1A	1.45
R-205	24	260	2C	1.55
R-536	27	230	2C	1.55
R-220	75	5000	1C	1.50
R-627	115*	...	1A DB	3.10
R-698	12	75	1C	1.20
R-734	24	150	3C/10 Amps	1.30
R-598	28	185	2C	1.30
R-622	20/30	200	3A & 2C/10 Amps	1.45
R-274	24*	...	2A	1.55
R-270	24*	...	1A	1.55
R-269	24*	...	1A/15 Amps	1.55
R-277	12	30	2C-DB Ceramic	2.20
R-594	12	50	2C	2.00
R-668	12	50	1C/10 Amps	1.30
R-618	12	50	1C	1.30
R-772	12	70	1A/15 Amps	1.45
R-293	12	150	1C DB	3.10
R-697	12/24	100	1A/10 Amps	1.45
R-580	12/24	150	1C DB	2.45
R-276	24	100	2C DB Mica	3.10
R-752	24	150	2C/3 Amps	1.45
R-768	24	175	2A/5 Amps	1.45
R-699	24	200	3C/5 Amps	1.55
R-700	24	200	2C/8 Amps	1.55
R-282	24	345	1A-DB	1.25
R-286	115*	950	2C	2.80
R-612	2/6	1	1A	1.55
R-815	2/6	1.5	1A/10 Amps	1.55
R-263	6	12	2C/15 Amps	1.55
R-279	14	250	1A/15 Amps DB	1.55
R-278	18/24	260	2C, 1A, 1B	1.55
R-706	24	150	4C/10 Amps	2.45
R-177	24	250	4C	2.05
R-609	250	5000	1A-DB	2.45
R-779	12*	...	1B/10 Amps	1.70
R-272	24*	...	1A, 1B/5 Amps	1.55
R-271	24*	...	2A, 1B/3 Amps	1.55
R-685	115*	600	1A/6 Amps	2.50
R-663	12	40	2C/10 Amps	1.30
R-737	12	44	2C, 1A, Ceramic	1.45
R-152	12	50	2C, 1B, Ceramic	1.35
R-624	12	50	1C	1.45
R-268	12/24	260	3A, 1B	1.55
R-805	18	200	1A/10 Amps	1.30
R-644	18/24	275	1A/25 Amps & 1A/5A	1.45
R-687	23.5	125	2C/15 Amps & 3A/10 A	2.45
R-674	24	250	1C/5 Amps	1.45
R-593	28	125	2C/10 Amps	1.45
R-191	28	125	2C/10 Amps Ceramic	1.50
R-248	28	150	1A/20 Amps	1.30
R-615	32/40*	...	3A/15 Amps	1.55
R-582	120*	...	1A	2.45

Stk. No.	Voltage	Ohmage	Contacts	Unit Price
R-812	115*	...	1A-DB 15A	2.45
R-260	115*	500	3A/15 Amps	2.80
R-249	100/135*	600	2A Ceramic	2.80
R-665	115*	500	2B/10 Amps	2.80
R-693	2/6	125	1C/3 Amps	1.10
R-597	4/12	16	1A/25 Amps	2.45
R-193	5/8	11	2C, 1A/10 Amps	1.30
R-595	5/8	18.5	3C	1.30
R-692	6/24	1280	1C/3 Amps	1.35
R-793	12	42	2C/10 Amps	1.55
R-599	12	67	3A/15 Amps	1.45
R-559	24	95	1A/10 & 20 Amps	1.30
R-560	24	160	1A	2.80
R-795	24	160	2A/10 Amps	1.55
R-796	24	160	2A/15 Amps	2.80
R-562	24	160	4A/10 Amps	1.60
R-797	24	160	8A/8 Amps	2.80
R-549	24	160	1C/10 Amps	1.55
R-758	24	160	2C/10 Amps	1.55
R-242	24	170	1C/20 Amps	1.55
R-675	24	180	2A/10 Amps	1.50
R-649	24	265	1A	1.30
R-744	24	265	1A/20 Amps	1.50
R-530	24	265	2A/10 Amps	1.45
R-574	24	265	2B	1.30
R-791	24	375	2C/10 Amps	1.55
R-775	28	180	2C Ceramic	1.55
R-776	28	265	2A	1.55
R-701	22/28	425	2B/10 Amps	1.70
R-802	24	160	3A DB 15 Amps	2.80
R-792	24	200	1A/15 Amps	1.30
R-798	24	500	1C/5 Amps	2.40
R-695	12	70	2C/3 Amps	1.30
R-288	18/24	175	2A Ceramic	2.20
R-558	24	280	2C/3 Amps	1.55
R-299	6	24	2A	1.55
R-267	12	65	2C/5 Amps	1.55
R-786	60	1300	2C	2.00
R-588	90/125	6500	4C	2.70
R-755	24	300	1A	1.45
R-150	6	30	1A	1.20
R-640	24	330	1C/3 Amps	1.50
R-148	12	100	2C & 1B	1.35
R-285	12	75	3A	1.35
R-222	12	100	2A	1.20
R-639	6	20	3C/3 Amps	1.45
R-696	24	230	1A/8 Amps	2.00
R-143	24	280	1A	1.45
R-141	24	280	3A	1.45
R-140	24	280	1C	1.45
R-590	24	300	2B	1.25
R-540	24/32	300	2C	1.50
R-543	24/32	300	4C	1.50
R-743	110	5000	3B & 1A	2.05
R-783	100	6500	1C-Micalex	2.40
R-782	100	6500	4C & 1A	2.45

SPECIAL RELAYS

R-503	12/32	100	3A, 2C	$2.80
R-749	600	...	Max. 28 Amps	7.45
R-804	550*	...	1B/38 Amps	4.35
R-250	115*	...	Adj. Cir. Br. .04-.16A	17.50
R-579	220*	...	1B	8.70
R-294	27.5	200	1B	5.35
R-686	115*	...	2C	6.10
R-246	115*	...	1B	11.20
R-246A	115*	...	1A	11.20
R-611	24*	...	1A/30 Amps	5.35
R-283	12	125	1C/10 Amps	1.25
R-614	18/24	60	1A/15 Amps	4.35
R-262	...	200	1C	4.70
R-245	12	25	4" Micalex Lever	1.20
R-527	6/12	50/50	In Series	1.20

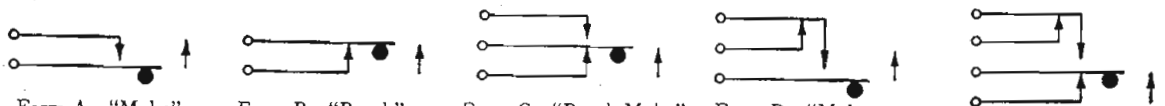
Stk. No.	Voltage	Ohmage	Contacts	Unit Price
R-544	12/24	60/60	1C	2.05
R-255	....	....	1A	1.20
R-669	75*	400 Cy.	1B, 1A	1.20
R-660	6	...	⅜" Stroke	1.20
R-651	24	100	Solenoid Valve	3.10
R-295	12	275	Annunciator Drop	2.70
R-230	5/8	2	2A, 1C	2.70
R-813	12	12	Wafer	5.35
R-275	12	750	1A, 1B, 1C	3.45
R-716	24	70	2A/5 Amps	1.60
R-620	6/12	35	2C, 1A	1.30
R-529	9/14	40	1C/10 Amps	1.55
R-720	24	50	2C Ceramic	1.70
R-500	12	10/10	2C/6 Amps	3.55
R-816	12	10/15	2C/6 Amps	3.55
R-524	24	AC-DC	.....	1.20
R-566	115*	**	.....	1.00
R-710	....	150**	.....	.75
R-811	48	8000	1C	2.05
R-206	24	150	5C	1.50
R-207	24	210	4C	1.35
R-219	50	1500	2A/15 Amps	1.55
R-531	12/24	80	2A/10 Amps	1.50
R-506	24	300	2A/6 Amps	1.20
R-581	24	4500	1A/5 Amps	1.20
R-825	115*	...	1A/6 Amps	2.45
R-819	115*	...	2A/6 Amps	2.45
R-652	115*	...	1A DB/20 Amps	2.80
R-217	115*	...	1C	2.80
R-824	2	.75	1C	1.55
R-600	8/12	5000	1C	2.80
R-820	10	20	1B DB/6 Amps	1.30
R-821	18	2000	1A, 1B/2 Amps	2.45
R-587	24	160	2C/10 Amps	1.55
R-739	24	200	1A	1.35
R-724	75	2200	2B/3 Amps	2.40
R-823	110	5000	1B	2.45
R-817	12	600	1C, DB	1.30
R-729	12	80	1A/10 Amps	1.25
R-722	24	300	1A/10 Amps	1.30
R-577	48	220	2C	2.45

MIDGET RELAYS

R-572	24	256	1C	$1.25
R-291	6	5	1A	1.25
R-738	12	90	3A	1.20
R-144	12	228	1A	1.45
R-145	18/24	250	2A-Ceramic	1.45
R-298	21	300	1A	1.25
R-296	21	300	1A	1.25
R-586	21	300	1A & 1C	1.25
R-137	24	300	1C	1.45
R-142	24	400	2C	1.50
R-785	24	200	2C/10 Amps	2.00
R-607	24*	...	1A	1.20
R-606	24*	...	1A & 1B	1.20
R-605	24*	...	3A	1.20
R-728	6	30	1A	1.25
R-807	6	30	2C	1.25
R-625	6	45	1C/3 Amps	1.35
R-732	12	120	1A	1.45
R-733	12	120	2C	1.50
R-281	12	126	2A	1.25
R-818	18/24	300	1B	1.25
R-139	24	200	4C	1.45
R-135	24	250	1B	1.45
R-133	24	300	None	.75
R-138	24	300	4A	1.45
R-132	24	300	2C	1.50
R-731	24	300	2C	1.55
R-730	24	300	2C & 1A	1.55
R-292	24	350	1C	1.25
R-626	24	400	1A/5 Amps	1.55

* Denotes AC — others DC
** = Coil only.

BASIC CONTACT ASSEMBLIES SHOWN IN UNOPERATED NORMAL POSITION



Form A—"Make" (Single Throw, Normally Open)

Form B—"Break" (Single-Throw, Normally Closed)

Form C—"Break-Make" (Double-Throw)

Form D—"Make-Before-Break"

Form E—"Break-Make-Before-Break"

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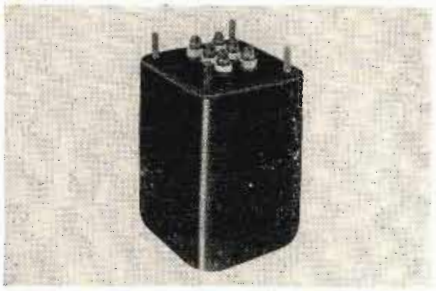
Tele-Tech
Advertisers - June 1951

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Transformers

A new line of hermetically-sealed transformers has been developed. They are available in all sizes with ceramic or glass seals, and are built in accordance with MIL-T-27 JAN-T-27 specifications—**Midwest Coil and Transformer Corp., 1640 N. Halsted St., Chicago 14, Ill.**—TELE-TECH



Polar Recorder

A new high-speed polar recorder, designed for both linear or square-root plotting in polar coordinates, is now available in standard portable (PRS-1) and deluxe console (PRS-1A) models. The recorders are ideally suited to rapid recording of antenna, illumination, sonar and directional sound patterns, and physical properties as a function of angle.

The unit operates an ac. input with a frequency range from 100 to 60,000 cps dc; input can be provided on special request without additional charge. Full scale response on ac, is approximately .5 volts, and 5 volts on dc. The power supply is 115 volts, 50/60 cycle, 230 watts. Unless otherwise specified, Selsyn motor type is 50/60 cycle, 115 volts. Gear ratio is specified by the user.—**Antenna Research Laboratory, Inc., 797 Thomas Lane, Columbus 14, Ohio**—TELE-TECH

Loop Antenna

Because it incorporates a revolutionary new departure in design, the new Grayburne Ferri-Loopstick broadcast radio loop antenna combines highest efficiency, highest sensitivity and omni-directivity with low cost and the small size (2 in. long). It vastly increases the sensitivity and signal-to-noise ratio of receivers. It pulls in those hard-to-get stations that normally can't be heard with ordinary loop antennas. Ferri-Loopstick is said to be equally sensitive and efficient at every angle, while ordinary loop antennas require orientation for best reception.—**Grayburne Corp., 20 South Broadway, Yonkers 2, N. Y.**—TELE-TECH

New Knight Division

Lester B. Knight & Associates, Inc., Chicago and New York consulting engineering and management organization, has added a personnel training division to its services for the radio-electronic industry. This service is headed by Richard L. Bradley who has had many years experience with the corporation service division of LaSalle Extension Univ. and Aldens, Inc.

Microwave Test Equipment

Kings Microwave Inc., 50 Marbledale Road, Tuckahoe 7, N. Y., has published a brochure on its line of microwave test equipment and accessories.

Tube Characteristics

"Special Purpose Tube Characteristics" is the subject of a new bulletin recently issued by Raytheon Manufacturing Co., 55 Chapel St., Newton 58, Mass.

Capacitors

Aerovox Corp., New Bedford, Mass., has announced the availability of a new bulletin on metallized paper capacitors. Early history, manufacturing processes and characteristics of metallized paper capacitors are a few of the topics covered.

Tapes for TV

Technical data on electrical tapes used in the construction of television equipment is given in a new 8-page booklet available from Minnesota Mining and Manufacturing Co., St. Paul. The new "Tapes for Television" booklet reports on various proved production uses for the tapes, and provides technical data on 7 electrical tapes and 1 filament tape.

Measurements Laboratory

A 16-page, two-color brochure (GED-1406) describing the varied facilities of, and the work conducted in, the new $2,000,000 Measurements Laboratory of the General Electric Meter and Instrument Divisions, has just been released by the company. It is available from the General Electric Co., Schenectady 5, N. Y.

Sound Equipment

Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Cal., has issued a new sound catalog. Features include the new listing of jacks and accessories; price reduction on control knobs and dials, and new products include the new orthacoustic equalizer, type 4137-B.

Rubber-Sealed Plugs

Cannon Electric Development Co., 3209 Humboldt St., Los Angeles 31, Calif., has issued a four-page bulletin on its new line of "RS" hermetically-sealed plugs used largely on aircraft relays and other sealed components. Some 21 complete connector assemblies are now available based on MIL-C-5015 Specifications and conforming to AND10459, under "Sealed" classification "D."

New Monthly Bulletin

Melpar, Inc., 452 Swann Ave., Alexandria, Va., announces availability of a new monthly bulletin describing their latest technological advances. Three "Technical Bulletins" have already been published the first and second of which discuss potting resin for subminiature assemblies and subassemblies. The third issue describes a miniature radar beacon operating in the 2700-2900 MC. Interested parties will be mailed this monthly bulletin upon request.

R-F Generator

A new eight-page bulletin describing Sweepmaster I, video sweep generator, has been published by Manufacturers Engineering and Equipment Corp. of Willow Grove, Pa. Sweepmaster I is a radio frequency generator designed to be used in conjunction with any standard cathode-ray oscilloscope when aligning wide band amplifiers or, more generally, when observing a frequency response characteristic.

Tube Characteristics

A new comprehensive catalog that summarizes the basic characteristics of all the vacuum tubes manufactured by Eitel-McCullough, Inc., is now available. Write to the Application Engineering Department, Eitel-McCullough, Inc., San Bruno, Calif.

Opportunities for Engineers

RESEARCH AND DEVELOPMENT ENGINEERS
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The expanding program of Sylvania Central Laboratories on Long Island offers challenging opportunities in electronics. Assignments are of a permanent nature and will provide invaluable experience in the research and development phases of dynamic new fields.

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W. A. Busch, *Personnel Director*

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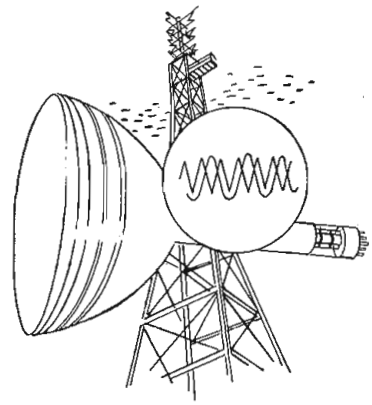
DUMONT



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INTERVIEWS

Mr. George Kaye—Industrial Relations Division
Allen B. Du Mont Laboratories, Inc.
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depreciation of radio broadcast equipment is quite high, therefore, it is much better to purchase accessory equipment as conditions warrant its use, rather than sell surplus purchases—in a peacetime economy.

A good supply of hand tools, as well as test equipment, is important. It is axiomatic in any trade or profession that good tools can save time and money. Such other technical accessories as inter-office communications, waste heat blowers and emergency equipment are very desirable. Communications between transmitter building and tower is very important for checking remote antenna current meter, etc. Also, spare equipment should be provided for use in case of an emergency or irregular operation. Fixed pads, line transformers, bridging transformers and amplifiers are good examples.

Planning a broadcast station is a complex problem and requires a lot of work . . . and worry. It cannot be done on a step-by-step basis, rather, it must be done all at once. Each step will have an effect on every other step. All planning should be done with these two thoughts in mind: (1) plan for future expansion —any well operated business will expand in due course; (2) provide for flexibility of operation;

REFERENCES

1. Hidden Headaches in Building a Broadcast Station, TELE-TECH, July 1949.
2. Console Modifications Provide Audio Flexibility, Q. Cumeralto, TELE-TECH, July 1950.
3. National Association of Broadcasters Handbooks, FCC Standards of Good Engineering Practices.
4. Broadcast Operators Handbook, H. E. Ennes, John F. Rider Publishing, Inc.
5. How to Select Antenna Towers and Mast, W. Schwartz, Electronics, December 1950.
6. The Architecture of Broadcast Transmitter Buildings, Western Electric Oscillator, September, 1947.
7. Planning the Transmitter Building, J. Vassos, S. W. Pike, RCA Broadcast News, March 1948.
8. Planning Radio and Television Studios, G. M. Nixon, RCA Broadcast News, December 1948.
9. The Control of Sound in Broadcast Studios, Published by Johns-Manville.
10. Noise Isolation in Broadcast Studios, J. B. Ledbetter, Radio News, Radio Electronic Engineering Edition, July 1949.
11. Instructions for RCA Speech Input Consolette, Type 76-B2.

New Lowell Company Name

Lowell Metal Products Corp., St. Louis, Missouri, pioneer manufacturers of ceiling and wall speaker baffles and allied acoustical equipment, announces a change of name to Lowell Manufacturing Co., same address. No changes in personnel are anticipated, according to word received from Ben W. Lowell, head of the firm.

"Second Chance" for Engineering Education

Majestic Radio has announced the establishment of Majestic Research Fund Inc., endowed by Leonard Ashbach for $500,000. Grants up to 48 scholarships per year for 5 years, each worth about $2000, will be made to persons over 35 years of age seeking a "Second Chance" for education. The advisory board includes Dean H. L. Masson, Engineering Graduate School, New York University; Dean Erich Hausman, Brooklyn Polytechnic Institute; Prof. R. T. Livingstone, executive officer, Dept. of Industrial Engineering, Columbia University; and Prof. David Bendel Herz, Columbia University.

Niemann Heads NPA Section

Louis H. Niemann of Sylvania Electric Products Inc. has been chosen to serve as chief of the electron tube section of the electronics division, National Production Administration. Niemann is on leave of absence from his position with Sylvania as manager of sales engineering for the sales department of the Radio Tube and Television Picture Tube Division.

Chief functions of the Section are to determine the production capacity of the electron tube industry to meet both military and essential civilian demands and to supervise allocation of tubes or materials to manufacturers.

STATION CONSTRUCTION

(*Continued from page* 36)

Having installed the conduit, "pulling through" the interconnecting wires is the next project. As mentioned earlier, it is a good idea to add a couple of extra pairs between console and audio rack for future use.

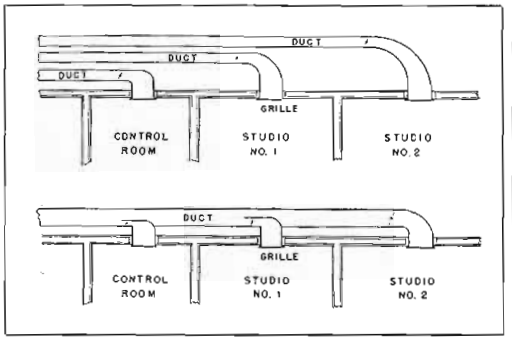
To reduce noise level, cotton covered shielded pairs should be used for all inter connecting wiring which is installed in conduit or duct work. Installation of lead covered wire in all conduit terminating in the transmitter, audio and ac, will provide a higher degree of r-f shielding. It is important to ground both ends of the shield on all pairs.

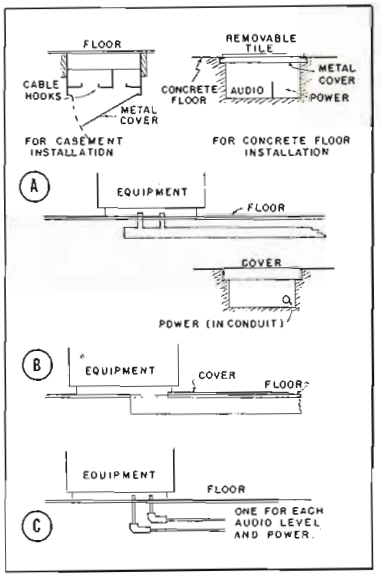
The various audio level, ac, control circuits, etc., should be separated as much as possible at both the console and the audio rack. To help in keeping the pairs or groups of pairs separated, and to give the installation a workmanlike appearance, the use of lacing cord is highly recommended. A standard method of connecting the pairs to the terminal blocks and plugs will also improve the over-all appearance. For example: all black leads to odd number terminals and all red leads to even terminals. Wall plug and microphone extensions should be standardized in this respect, also. This will eliminate confusion when repairs are necessary.

Equipment Requirements

Equipment requirements depend upon the power of the station and the scope of the operation. The basic equipment will consist of the transmitter, console, interconnecting link between studio and transmitter, and associated equipment, such as audio racks, mikes, etc. Accessories are then added to the basic equipment. Cutting tables, tape recorder, remote equipment, and spare equipment are examples. Two common errors of the inexperienced broadcaster is over-buying accessories and under-buying basic equipment, spare audio rack space is a good example. The

Right: Raceway (A), Trench (B), and conduit (C) methods of protecting and carrying cable
Below: Air conditioning ducts should be separate and not feed all points from single outlet





MILITARY CONTRACT AWARDS

Manufacturers who have received contract awards for producing of radio-radar-electronic equipment for the Armed Services are listed below by name, city and equipment. Subcontractors interested in bidding on performance of any part of each contract should sell their services to these prime contractors. This list, which is current np to our press time, covers the period from March 28 to May 2.

Altimeters

Kollsman Instr. Corp., Elmhurst, N. Y.; Radio Corporation of America, RCA Victor Div., Camden, N. J.

Amplifiers

Aviation Engrg. Corp., Woodside, N. Y.; Maxson Engrg., Div., W. L. Maxson Corp.; Western Electric Co., Inc., N. Y. City; Video Corp. of America, N. Y. City; Westinghouse Electric Corp., N. Y. City.

Antennas

Bendix Radio Div., Bendix Aviation Corp., Baltimore, Md.; Camfield Mfg. Corp., Grand Haven, Mich.

Capacitors

Cornell-Dubilier Electric Corp., South Plainfield, N. J.; John E. Fast & Co., Chicago, Ill.; Federal Mfg. & Engineering Corp., Brooklyn, N. Y.; Micamold Radio Corp., Brooklyn, N. Y.; Sangamo Elec. Co., Springfield, Ill.; U. S. Radio & Television Supplies, Chicago, Ill.

Coils and Transformers

Coil Winders, Inc., Brooklyn, N. Y.; General Electric Co., Chicago, Ill.; Raytheon Mfg. Co., Waltham, Mass.; Stewart-Warner Corp., Chicago, Ill.

Converters

Electronic Measurement Co., Eaton, N. J.

Electron Tubes

Chatham Electronics Corp., Newark, N. J.; Allen B. DuMont Labs., Inc., Clifton, N. J.; General Electric Co., Schenectady, N. Y.; National Radio Corp., Orange, N. J.; Radio Corporation of America, RCA Victor Div., Harrison, N. J.; Raytheon Mfg. Co., Gov't Contracts Dept., Waltham, Mass.; Sylvania Elec. Products, Boston, Mass.; Westinghouse Electric Corp., Chicago, Ill.

Generators

Bendix Radio Corp., Teterboro, N. J.; General Electric Co., Philadelphia, Pa.

Headsets

Roanwell Corp., Brooklyn, N. Y.

Indicators

Bendix Aviation Corp., Eclipse Pioneer Div., Teterboro, N. J.; General Elec. Co., Schenectady, N. Y.; Kollsman Instrument Corp.; Elmhurst, N. Y.; The Lewis Engineering Co., Naugatuck, Conn.; Weston Electric Instrument Corp., Newark, N. J.

Microphones

Connecticut Telephone & Electric Corp., Meriden, Conn.

Oscillators

G. & M. Equip. Co., North Hollywood, Calif.

Photographic Equipment

Aeroflex Laboratories, L. I. City, N. Y.; Bell & Howell Co., Chicago, Ill.; Electronic Tube Corp., Phila., Pa.; Fairchild Camera & Instr. Corp., Jamaica, N. Y.

Radar Equipment

Bendix Radio, Div., Bendix Aviation Corp., Baltimore, Md.; Fairchild Camera & Instrument Corp., Jamaica, N. Y.; Federal Telephone & Radio Corp., Clifton, N. J.; General Electric Co., Syracuse, N. Y.; Gilfillan Bros., Los Angeles, Calif.; The Magnavox Co., Fort Wayne, Ind.; Radiomarine Co., New York City; Webster Chicago Corp., Chicago, Ill.

Radio Transmitter, Receiver

Aircraft Radio Corp., Boonton, N. J.; Bendix Radio Div., Bendix Aviation Corp., Baltimore Md.; Bendix Radio Div., Bendix Aviation Corp., Teterboro, N. J.; Cincinnati Electronics, Cincinnati, Ohio; Collins Radio Co., Cedar Rapids, Iowa; Designers for Industry, Cleveland, Ohio; Eclipse Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.; Federal Telephone & Radio Corp., Clifton, N. J.; Federal Mfg. & Engr. Corp., Brooklyn, N. Y.; Gates Radio Co., Quincy, Ill.; Hallicrafters Co., Chicago, Ill.; Hammarlund Mfg. Co., N. Y. City; National Electronic Corp., Indianapolis, Ind.; Remler Co., San Francisco, Calif.; Setchell Carison, Inc., New Brighton, Minn.; Wilcox Elec. Co., Kansas City.

Relays

Kellogg Switchboard & Supply, Chicago, Ill.; Kurman Elec. Co., L. I. City, N. Y.

Resistors

Radio Corp. of America, Harrison, N. J.; Stackpole Carbon Co., St. Marys, Pa.

Searchlights

Westinghouse Elec. Corp., Washington, D. C.

Signal Generators

The Daven Co., Newark 4, N. J.; Harvey Wells Electronics, Southbridge, Mass.; Hewlett-Packard Co., Palo Alto, Calif.

Telephone, Telegraph Equipment

Connecticut Telephone & Elec. Corp., Meriden, Conn.; Federal Telephone & Radio Corp., Clifton, N. J.; Radio Corp. of America, Camden, N. J.; Radio Frequency Laboratories, Boonton, N. J.; Teletype Corp., Chicago, Ill.

Test Equipment

General Radio Co., Cambridge, Mass.; Hoffman Radio Corp., Los Angeles, Calif.; Kings Microwave Co., Inc., Tuckahoe 6, N. Y.; Lavoie Labs., Inc., Morganville, N. J.; Panoramic Radio Products, Inc., Mt. Vernon, N. Y.; Trad Television Corp., Asbury Park, N. J.; Westinghouse Electric Corp., Phila. 4, Pa.

Voltage Regulators

Bendix Aviation Corp., Eclipse-Pioneer Div., Teterboro, N. J.; General Elec. Co., Washington, D. C.

TV: Consoles and Chains

Columbia Broadcasting Co., N. Y. Clty; RCA Victor, Div. Radio Corp. of America, Camden, N. J.

Wire Recorders

Air King Products Co., Brooklyn 32, N. Y.

Melpar Opens Plant in Massachusetts

Melpar, Inc., with main plant and general office at Alexandria, Va., has announced the opening of a branch plant at 10 Potter Street, Cambridge, Massachusetts. The new plant, with 9,000 square feet of space, will be devoted primarily to applied research and advanced development work on electronic equipment for the armed forces. The company is making this move to obtain even closer cooperation with the universities in the Cambridge area and to expand Melpar's work on applications of the new statistical theory of communication.

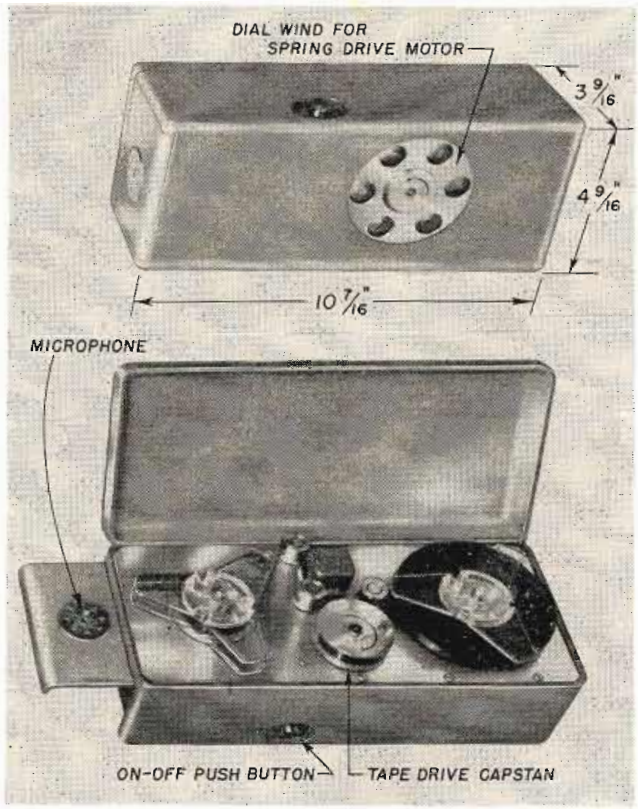
New Portable Tape Recorder

Photo of new professional-type portable magnetic tape recorder to be distributed by Audio & & Video Products Corp., 1650 Broadway, N. Y. C.

Operating tape speed of 1⅞ in. per second is obtained from constant torque spring wound motor. Dual track recording is employed and frequency response is 100-5000 cps ± 2db.

A 90 volt battery provides power for amplifier and bias oscillator and is rated at 100 hours life. A 500-ohm output terminal operating at 0 db level is provided. Signal to noise ratio is 45 db. Unit weighs only 3½ lbs. complete.

For additional information see Tele-Tech, May 1951, Page 76. See also "Audio" p. 27,, this issue.



TV Intermodulation Tests

(*Continued from page 33*)

do not present the same impedance to the receiver terminals can result in higher or lower intermodulation figures.

2—One undesired signal at the frequency plotted on abscissa.

3—Second undesired signal at a frequency on the same side of the desired channel as the first, but twice as far removed.

4—Receiver adjusted for 500 MC.

The ordinate shows the on-channel interfering signal which is equivalent to that produced by intermodulation between the two undesired signals. The shape of the curve in Fig. 2 shows the effect of front-end selectivity of the receiver which was equipped with two tuned circuits ahead of the crystal mixer.

Intermodulation between TV signals in a band where the channels are spaced equally will result in interference which will be essentially the same as co-channel TV interference. As in the co-channel case, offset carrier frequency spacing may be invoked to reduce the effect of the interference. However, combined use of the offset carrier method, for co-channel and intermodulation reduction, may not always be feasible.

Aeronautics Division; (e) Research Division; (f) Flight Test Division and (g) Materiel Division.

The Weapons Systems Division will contain an aircraft section, a guided missile section, an analysis section, and a special weapons section. All Weather Flying Division, as before, will seek methods to enable Air Force planes to complete missions regardless of weather conditions. The Division will have both an Engineering and Operations section.

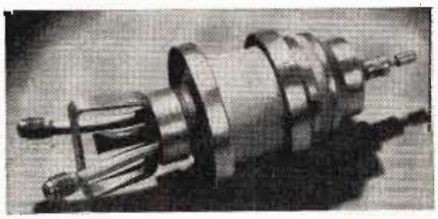
Weapons Components Division will encompass the following laboratories: Aircraft Radiation, Communication and Navigation, Components and Systems, Equipment, Armament, and Photographic. The Aircraft Lab and the Propeller and Power Plant Laboratories will make up the Aeronautics Division.

Research Division will take over the Aero Medical Lab, the Materials Lab, and the Computation and Simulation Lab (formerly the Office of Air Research). The Flight Test Division will control bomber, fighter, cargo, and special projects flight test sections, as well as a Test Aircraft Maintenance Section.

Finally, the Materiel Division will be made up of a Fabrication and Maintenance Section, a Supply Section (local supply only), a Local Procurement Section and an Air Installations Section.

New UHF Ceramic Tube

The new General Electric type GL-6019 is an all-ceramic and metal power tube, capable of operating up to and beyond the top frequency (890 MC) of the proposed UHF television channels. The use of ceramic in the new tube minimizes the problem of high-frequency losses and makes envelope cooling problems less difficult compared to glass tubes. Other features include: a gold-over-silver plating on all external metal parts provides low-loss electrical contacts; concentric ring-seal construction enables the tube to be easily inserted or removed from its cavity; water pipes are so arranged that connections can be made outside the r-f cavity. Maximum ratings of the GL-6019 at synchronizing level for Class B TV service include: dc plate voltage, 4,000 volts; dc screen voltage, 600 volts; dc plate current, 700 ma; plate input, 2.5 kilowatts; plate dissipation, 2 kilowatts.



Stone Named Trustee

J. McWilliams Stone, founder and president of Operadio Manufacturing company, St. Charles, Ill., has been named to the board of trustees of Illinois Institute of Technology.

MAGNETRON DEVELOPMENT

(*Continued from page* 51)

Laboratory tube operating successfully in this wave length region. This tube, designated as the AX5, had a correction constant k=1.11 and the ratio of cavity sizes W/w was 1.65. Increasing this ratio increases mode separation, but increases the n=zero mode r-f field contamination, thus penalizing the efficiency especially in the region of the cyclotron frequency. The tuning as described later in this report is accomplished by inserting a pin in the back of one of the large resonators and thus effectively reduces the cavity ratios. In order to insure an adequate mode separation when tuning, the ratio W/w=1.74 was chosen. During the development of this tube, the correction constant k was changed from 1.11 to 1.141 by trial and error. Thus we have:

$$W/w = 1.74 \qquad (9)$$

$$(W + w) = (\lambda/k) \qquad (10)$$

$$W + w = (3.225/1.141)$$

$$2.74w = 2.82$$

$$w = 1.03 \text{ cm}$$

$$W = 1.79 \text{ cm.}$$

$$W = (1 + \tfrac{\pi}{18}) D_w - D_a \text{ cm.}$$

$$D_w = 1.71 \text{ cm.} = .677 \text{ in.}$$

$$W = (1 + \tfrac{\pi}{18}) D_a - D_a \text{ cm.}$$

$$D_a = 1.075 \text{ cm.} = .422 \text{ in.}$$

In selecting the anode height, a good deal of latitude is allowed since it is known that the operating anode current can range from 1/30 to 2 times I_o as given by Equation (4) for good operation, and in the rising sun anode, moding is independent of anode height. From experience with other tubes the anode height was selected as 0.2 in. To check, we can substitute in Equation (4)

$$I_o = \frac{5.23 \times 10^5 D_a^2 h}{(1-s^2)^2 (\frac{1}{s}+1)(n)^3}$$

$$I_o = \frac{5.23 \times 10^5 (.23)^2 (.51)}{(1-0.6^2)^2 (\frac{1}{.6}+1)(9)^3 (3.22)^3}$$

$$I_o = .53 \text{ amps.}$$

In order to obtain 100 watts output at 30% efficiency, we calculate the current needed from the equation:

$$P = \eta V I \qquad (12)$$

Solving for I

$$I = \frac{P}{\eta V} = \frac{100}{(.3)800} = .417 \text{ amps.}$$

Thus I is well within the range of good operating conditions.

It is now possible to check the required emission density of the cathode emitting area. The cathode area is:

$$A = \pi D_c h = \pi (.137)(.508) \qquad (13)$$

$$A = 219 \text{ sq. cm.}$$

Emission density is given by

$$J = \frac{I}{A} = \frac{.417}{.219} = 1.9 \frac{\text{amperes}}{\text{sq. cm.}} \qquad (14)$$

This value is reasonable for a pulsed duty cycle of .003.

Part Two will appear in the July issue.

Air Force Procurement Changes

Since the printing of our Air Force Procurement Chart, (TELE-TECH, May 1951, p. 34, 35) the following organizational changes have occurred: Research and development activities at Wright-Patterson Air Force Base and other Air Materiel Command installations have been officially transferred to the new Air Research and Development Command.

Under the new setup, what used to be known as AMC's Engineering Division, Flight Test Division, All Weather Flying Division, and the Office of Air Research are now redesignated the Air Development Force under the command of Brigadier General F. R. Dent, Jr.

Also placed under ARDC are Edwards Air Force Base at Muroc, Calif.; Holloman Air Force Base, Alamogordo, N. M.; Griffiss Air Force Base, Rome, N. Y.; the Cambridge Research Laboratories at Cambridge, Mass.; and an experimental squadron located at the Naval Auxiliary Air Station, El Centro, Calif.

Top ARDC officials are studying plans to take over supervision of several other Air Force research and development installations, including the Arnold Engineering Development Division, Tullahoma, Tenn., and Patrick Air Force Base at Cocoa, Fla., the USAF's long-range guided-missile proving ground.

Present plans call for the removal of ARDC Headquarters from Wright-Patterson to another base of operations in the Washington, D. C. area sometime in the very near future. The Air Development Force, however, will remain at the Dayton air base.

General Dent, former head of the old AMC Engineering Division, indicated that AMC still retains control over Air Force procurement, supply and maintenance, and service-test engineering.

His Air Development Force will be broken down into seven divisions:

(a) Weapons Systems Division; (b) All Weather Flying Division; (c) Weapons Components Division; (d)

to diameters and lengths, data are provided for concentricity, screw driver slot dimensions, hexagonal hole sizes as well as threaded spring type and spaded insert sizes. Copies of this new standard may be obtained by writing to the Metal Powder Association, 420 Lexington Ave., N. Y. 17, N. Y., and enclosing 25¢ per copy.

Sound Power Requirements in RTMA Bulletin

In a new 14 page Engineering Bulletin (No. 39) RTMA has compiled information obtained from extensive practical experience for use in relating the audio electrical power requirements of sound systems to indoor volumes and to outdoor areas. To determine the required electrical power consideration is given to (a) the location to be covered, (b) sound power level required for the type of program material to be reproduced, (c) the efficiency of the loudspeakers, and (d) the acoustic noise level in the location to be covered. The bulletin is entitled "Determination of the Audio Electrical Power Requirements of Sound Systems," and may be obtained through the RTMA Data Bureau, 489 Fifth Avenue, Suite 710, New York City.

New UHF Converter Developed by Crosley

Shown below is a photo of the new Crosley Ultratuner recently demonstrated in Bridgeport, Conn. This is a continuously tunable TV converter for use in the 480-890 MC band where the

current FCC proposal provides for 70 additional channels.

Designed as a packaged unit primarily for existing VHF receivers employing continuous tuning, the only connections required are the UHF and VHF antenna connections to the converter and a jumper between the latter and the existing receiver. The converter output frequency lies between channels 6 and 7 (122-132 MC).

Because frequency stability is considerably more difficult to maintain at UHF, intercarrier type receivers will be best suited for converters of this type.

BOOKS

Handbook of Power Resistors

Compiled by H. F. Littlejohn, Jr. Edited by Christian E. Burckel and Associates. Yonkers, N. Y. Published 1951 by Ward Leonard Electric Co., Mount Vernon, N. Y., Dept. 040. 195 pages 5 x 7½ in., price $3.00 postpaid.

Composed of eight chapters, this handbook is designed to furnish the reader with practical information on the construction, application and performance characteristics of power resistors.

The introductory chapter deals with fundamental definitions, standards, functions and calculations applicable to power resistors. Materials used in resistor construction are reviewed in Chapter II. Chapter III discusses the various types of power resistors from the low wattage vitreous enamelled wire wound to high current ribbon wound types. Data on performance and application of each type are in cluded. Chapter IV is devoted to the more important factors for proper resistor selection.

A list of the standard stock types and sizes of power resistors is presented in Chapter V. The next chapter discusses the steps in vitreous enamel resistor manufacture. NEMA resistor standards are reproduced in Chapter VII. The last chapter lists basic definitions and is followed by a useful data section containing conversion factors, drill and wire size table and symbols for power, control and measurements. The final pages include bibliography and references.—BFO

BOOKS RECEIVED

Essential Characteristics—Receiving Types

Published 1951, by General Electric Co., Tube Division, Schenectady, N. Y. A 107 page pocket-size handbook listing essential characteristics of all receiving tube types likely to be found in AM-FM-TV receivers. Included are basing diagrams, outline drawings, information on subminiature tube types and TV picture tubes. Available through General Electric or Ken Rad tube distributors. Price $0.35.

Converting to Large Picture Tubes

Published 1951 by the American Distributing Co., Baltimore 17, Md. Specific instructions on how to convert certain earlier 10 in. TV receivers to use 14 and 16 in. picture tubes. Includes detailed data on circuit and cabinet changes. 42 pages. Price $1.00.

Iron Core Standard

A newly issued standard, 11-51T, defines the terms commonly associated with powdered iron core materials and specifies preferred dimensions of standard sizes and shapes. Details are included for plain, insert, threaded, tuning, and sleeve iron cores. In addition

recoil without failure. All of this reliability, plus the ability to operate successfully in the arctic regions, at high altitudes, in the scorching heat of the desert, in sandstorms, and in the high humidity and molds of the tropics, illustrate why it takes special equipment design to meet the stiff military requirements.

Certainly desirable and an aim is the building of equipment, which can be sealed at the factory and never touched for thousands of hours. Perhaps enough reliability could be built in to preclude any servicing until the equipment were outmoded, and was simply discarded after many years of service. This goal has not been reached yet.

The next best thing is to make maintenance as easy and as rapid as possible. There is no doubt that, as equipments become more nearly automatic, they unavoidably become more and more complex. Designing for minimum and easy maintenance should be a very fruitful field.

Maintenance

Test sockets on each separable subunit permit the determination of faulty units rapidly using only a simple multimeter. Complete unit construction permits removing and replacing only a small part of the complete set when a failure does occur. Subminiature components and use of subassemblies permit pieces so small that many of them are considered "throwaways". In many cases it will be more economical to discard a faulty piece than to attempt to repair it. This will not only save maintenance time but will also permit the use of less skilled and trained personnel. The latter factor is a very important one in time of war when trained personnel may be at a premium. One big problem to which there is no complete solution yet is to make all major equipments repairable in the airplane without removing them to the service bench.

National Union to Build Philadelphia Plant

National Union Radio Corp. has purchased 50 acres of land in northeast Philadelphia as the site of a new electronic center, with construction to be started immediately on the first unit at a total investment of over $6,000,000. The announcement of this important move in the field of tube manufacturing was revealed by Kenneth C. Meinken, president of National Union, who explained that the new plant will employ about 1,600 people and the first unit will provide 130,000 sq. ft. for the manufacture of subminiature tubes.

(*Continued from preceding page*)

a radioteletype facility in military aircraft. This expedient would save at least half the bandwidth required for voice communication and would exclude some of the noise. Using the FSK facility, black and white facsimile could be furnished. For many operations, CW is still used. Now a CW "slot", only a few hundred cycles wide, without using a crystal filter can be provided. This slot is movable in the pass band of the receiver without affecting the crystal stability of the transceiver. A trained operator still can do amazing tricks in extricating his wanted signal from noise and other signals, where a voice signal might be unrecognizable as such, at extreme distance ranges.

Ever since aircraft have carried radio communications equipment, carbon microphones and diaphragm-type earphones have been used. The objectionable response peaks have been taken out of earphones, noise-cancelling microphones have been developed, but still there are inherent shortcomings. In the near future, dynamic, noise-cancelling microphones and dynamic earphones, increasing the intelligibility under high cockpit noise conditions, by some figure near 30% will be employed. Loudspeakers for standby listening within the aircraft and for external use in instructing ground crews in loading and maintenance operations can be added. We have built into the complete communications system audio AVC, speech clipping, and automatic altitude gain control to compensate for different voice levels, different speakers, and for loss in voice transmission through air at high altitude. Wire recorders used in aircraft and the recorder-reproducers used for ground playback are being improved.

Reliability

Maintenance problems of airborne radio communications equipments under actual operational conditions, are of vital concern. An inoperative piece of equipment might mean a fighter or bomber out of combat. Failure while in the air means an aborted mission, perhaps loss of the whole airplane and crew. This begins to touch on the reasons why the use of commercial type radio equipment cannot be considered. More and more reliability is being built into military equipment as the state of the art permits. Ruggedized vacuum tubes last for thousands of hours instead of hundreds. They can take the shocks of rough landings and gunfire

to estimate what further reductions will be practicable as the art progresses. Reduction in service rendered will invariably result in a decrease in size and weight, but the question of whether it is actually worthwhile must always be answered first.

There are occasions when the line-of-sight range provided by VHF and higher is insufficient due to distance or to intervening obstacles such as mountain ranges. There may be times also when the distance range of high-frequency transmitters needs to be increased. Distance range extension can be done most conveniently by using an airborne relay. Such a relay arrangement is small and simple, and requires but two sets of receivers and transmitters in the airplane, and two separate frequency channels. Relay operation can be completely automatic.

Up to now, and at present, one of the big enemies of long-distance communications, paradoxically, is the ionosphere, which makes long-distance communications possible. Nature is an enemy in this case only because it is permitted to be. It occurs because it is common practice to operate on fixed frequency assignments, usually made arbitrarily without regard to skip distances. Recently an airplane containing standard airborne radio equipment was flown to Seattle and thence to Fort Worth. Continuous voice communication was maintained all the way to Seattle from Wright-Patterson, a distance of 2125 miles. This was accomplished by properly choosing frequencies in advance, in accordance with ionospheric predictions. Frequencies were changed some six times on that trip, and at Fort Worth communications to the airplane were established while it was on the ground. This would indicate that anyone operating on a fixed frequency basis could greatly increase the reliable operating range with present high-frequency equipments, merely by using frequencies in accordance with predictions. Added transmitter power is not the answer if the frequency is wrong.

Food for thought is the possibility of developing an ionospheric computer to give the best frequency region for a given distance, time of day and season of the year. And, after that, perhaps a device attached to the transmitter to rapidly probe the ionosphere over the whole operating frequency range of the equipment to determine the region of the optimum frequency. Add to that, station selection, and perhaps you have an automatic communications system wherein a number is dialed as on the telephone, and the radio set does the rest. We have had, for a long time, equipments that remembered things. Our latest developments, such as automatic antenna tuning and loading, involve equipments thinking as well as remembering. Automatic equipments eliminate many human set-up errors and permit peak performance of equipment on every channel.

No one will question that the human voice is the most versatile of information sources. By its very nature, then, it requires a favorable signal-plus-noise to noise ratio. Also, therefore, it is least aided by application of communication theory such as correlation, since it is least repetitive and least predictable. Voice requires more bandwidth in the frequency spectrum than most other forms of modulation, unless it is itself synthesized, as in the Vocoder, something not yet practicable to carry in most airplanes. Perhaps, in many cases, a predetermined, fixed message may suffice in the way of communicated intelligence. In this case, visual displays of words or symbols could be used. This means is as yet to be adequately explored to its ultimate perfection.

We are at the point of providing

Military Airborne

(*Continued from page* 42)

sence, particularly on high-speed aircraft. In practically every case, the antenna will be within the normal contour of the airplane, and often actually an electrically-isolated part of the aircraft. Happily enough, these zero-drag antennas still have usable characteristics, some being as good or even better than their high-drag predecessors.

Sizes and Weights

To the engineer who has worked with airborne communications equipments, it is no mystery that, with everything else which must go into the airplane, ideally, the radio equipment should occupy no space and have zero weight. Since the days when radio was considered an unnecessary nuisance in an airplane, we have advanced to the point where it is not only tolerated, but is regarded as somewhat useful operationally, perhaps even a necessity at times. But, even so, size and weight are very critical considerations.

With practical maximum sizes and weights, the transmitter power output, which does somewhat affect reliable operating ranges, is necessarily curtailed. At VHF we had anywhere from two to perhaps eight watts depending on the human adjustment factor. This order of power appeared to be ample, since large increases would not extend the useful range beyond line-of-sight, anyway.

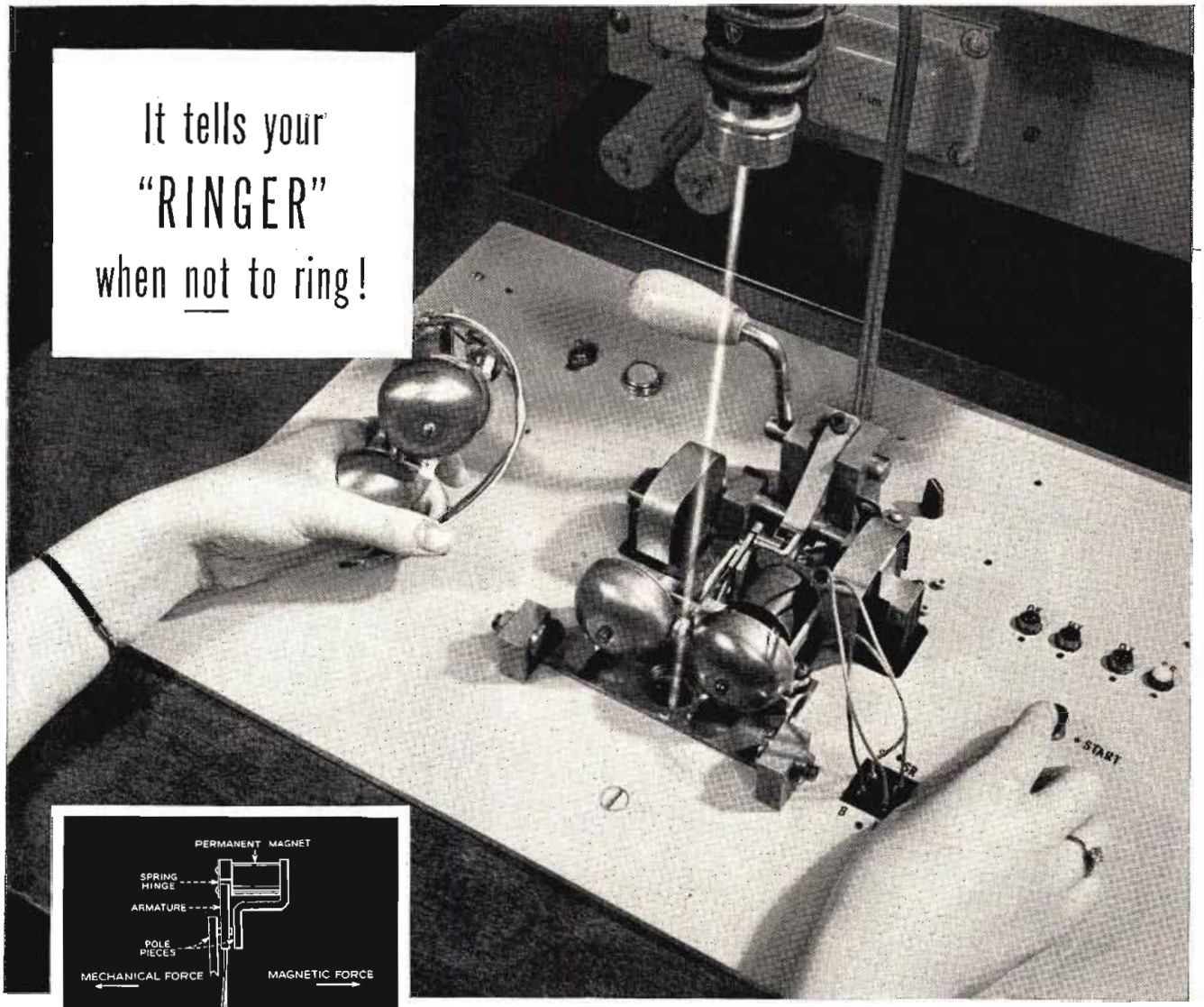
The problem is slightly different at the higher frequencies, where, due to the lambda-square law, more power might be more advantageous. At lower frequencies, atmospherics become more serious. Here we find that we must have at least 100 watts for normal operational uses.

Subminiaturization

For years we have been striving to reduce size and weight of all types of airborne equipment, and now subminiaturization techniques are proving fruitful. Instead of the present hundred pounds for line-of-sight equipment, half that weight without sacrifice in electrical performance can soon be realized. For long distance communications equipment, we are not too far above 100 pounds.

In size, one cubic foot looks feasible for line-of-sight transceivers, which is less than half of the present equipment volume. Two cubic feet will be required for high-frequency transceivers. Since these reduced volumes are realized through the use of the very new subminiaturization techniques, it is difficult, at this time,

It tells your "RINGER" when not to ring!



The Bell System's new automatic method of adjusting telephone ringers uses a beam of light passing between the gongs to a photoelectric cell. When test currents are applied to the ringer the machine decides whether to change the spring tension or the magnetic pull. After each change it tests again until the ringer is in perfect adjustment—and the whole procedure takes only 30 seconds.

To YOU, it's your familiar telephone bell. To telephone engineers, it's a "ringer." And it has two jobs to do. It must ring, of course, when someone calls you. And it must overlook the numerous electrical impulses which do not concern it, such as those sent out by your dial.

Ability to respond to some impulses, to ignore others, requires exact adjustment between the pull of a magnet and the tension of a spring. If they are out of balance your telephone might tinkle when it oughtn't, or keep silent when it should ring.

In the past, adjustment was made by hand, little by little until the proper setting was reached. It took time. But now Bell Laboratories engineers have developed a machine which adjusts new ringers perfectly, before they leave the Western Electric Company plants where they are made. And the operation takes just 30 seconds.

This is another example of how the Laboratories work constantly to improve every phase of telephony —keeping the costs low while the quality of service grows higher and higher.

BELL TELEPHONE LABORATORIES

WORKING CONTINUALLY TO KEEP YOUR TELEPHONE SERVICE ONE OF TODAY'S GREATEST VALUES

Washington Sees CBS Color-TV With Scanning Drums

To show a larger picture in color, CBS has built, and originally demonstrated in New York City in December, receivers with color filters mounted on a drum instead of a disc. This arrangement (first shown by RCA in Princeton, N. J., several years ago), permits a 17 in. picture without the use of lens. Inside a motor-driven lucite drum, 20 in. in diameter and 18 in. across, are mounted 9 color filter strips, 4½ in. x 18 in., arranged in groups of three, red, green and blue. A picture tube up to 20 in. in diameter can be placed inside such a drum to give a larger picture than is practical with the more usual rotating color disc.

In Washington in April such a receiver was demonstrated by CBS under the auspices of Rucker Radio Wholesalers. In the auditorium of the Chamber of Commerce the CBS camera, lights, control equipment, etc. necessary for a closed-circuit showing was installed with the help of the WTOP staff. During the 30 minute demonstration, before a lecture on CBS-color-Tv, the usual display of colored scarves, fruit, flowers, gold-fish and other colored objects took place under the experienced direction of Patty Painter, the CBS color demonstration girl.

The CBS drum color picture was judged to be equal to the best disc picture previously shown. The quality was rated: Good to Excellent. The picture was fairly bright and no flicker was noted except in the yellows. The fact that the geometrical detail was considerably less than standard 525-line monochrome was not very evident because close-ups predominated and none of the demonstration material required good resolution. Having watched the surprised and enthusiastic response of the average audience to color your reporter is at a loss to explain the mild interest in the picture on the part of the hundreds of radio-television men who attended this demonstration. Many, after a brief look at the receiver, passed by and took seats, awaiting the lecture; others appeared more interested in the improvised studio and its lights.

Philco Installs Microwave TV Relays for A. T. & T.

The American Telephone and Telegraph Co. has installed a Philco microwave television link between Cincinnati and Dayton, Ohio, supplementing existing television channels in that section. The equipment operates in the 6000-7000 MC frequency range and approaches the "true repeater" concept through the use of the double heterodyne remodulation principle.

SOLDERING GLASS TO METAL

Lawrence J. Hogue of the GE's General Engineering Laboratory, Schenectady, N. Y., makes final check of laboratory equipment used in soldering glass to metal. The parts being soldered are inside the covered metal shield under an evacuated glass bell jar which is heated by means of high frequency radiation from a copper coil. A thin layer of titanium hydride is painted on the areas to be soldered and a soft solder forms the vacuum-tight seal at approximately 900°F.

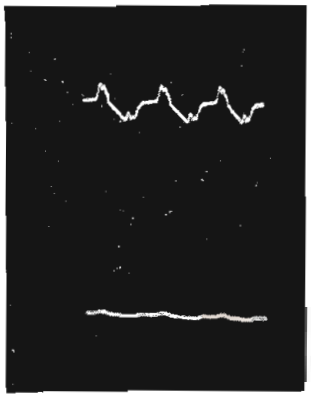
Where "Photographic Memory" Counts!

When you're comparing waveshapes it takes the "photographic memory" of a camera to give you the whole story in accurate, permanent form.

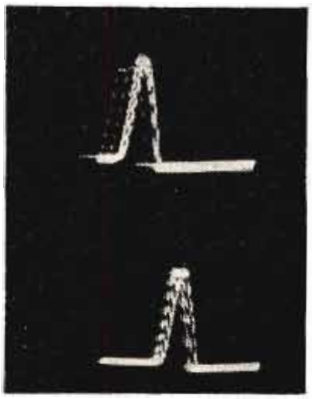
Until recently, photographic oscilloscope recording called for considerable trouble in setting up equipment and a long time period for developing the results. But today, with the Fairchild-Polaroid Oscilloscope Camera, it's an easy job to record as many traces as are needed.

Take a look at the prints below. They provided the engineer with valuable but inexpensive records for immediate evaluation. All were removed from the camera *one minute* after the final exposure was made.

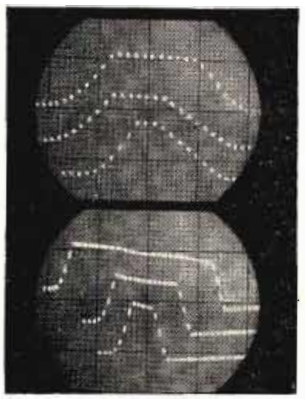
The stories of 3 "One Minute" Oscillograms



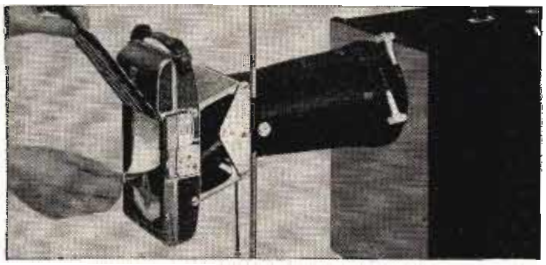
1. BEFORE AND AFTER. A visual comparison of "before and after" conditions is an easy job for the "one step" camera. Here, the upper trace shows the output of a full wave rectified power supply with insufficient filtering. The lower trace shows the effectiveness of the addition of a filtering condenser. The camera is easily adjusted to two positions (upper and lower) for two exposures; traces are exactly one half scope size.



2. SUPERIMPOSING FOR COMPARISON. The problem—determine the maximum time-interval variation between successive camera shutter openings and flash circuit closings. Instead of carefully measuring successive scope traces, the engineer superimposed several exposures for easy comparison. The length of the trace before the shutter opened is a measure of the time between the electrical contact closing and camera shutter opening.



3. MULTIPLE EXPOSURE PRE-SOLARIZATION. Here, by making 3 successive exposures on each half of the print, the engineer was able to record performance of a camera shutter at its 1/100, 1/200, 1/400 second (upper) and 1/25, 1/50, and 1/100 second settings (lower). "Pre-solarizing," the process of pre-exposing the print with the trace off the screen, made it possible to record the high writing speeds involved.



A minute after you've pulled the tab a finished print is ready for evaluation.

for still or *continuous-motion* oscilloscope recording on 35-mm film or paper

—THE FAIRCHILD OSCILLO-RECORD CAMERA

The Fairchild Oscillo-Record Camera is the first unit specifically designed for the purpose of recording cathode-ray tube images. Features: records still or continuous motion on standard 35-mm film or paper, film frontage indicator, electronic speed control—1 to 3600 in./min., film capacity—100, 400 or 1000 feet.

SPECIFICATIONS

Lens and Shutter—Choice of 75mm f2.8 Wollensak Oscillo-Anastigmat with #2 Alphax shutter having speeds of 1/25 sec. to 1/100 sec., "time" and "bulb"; or, 75mm f1.9 Wollensak Oscillo-Anastigmat with #3 Alphax shutter having speeds of 1 sec. to 1/100 sec., "time" and "bulb".

Picture Size—3¼ x 4¼ in. (2 or more images per print; 16 exposures per roll of film.)

Image Size—One-half reduction of scope image.

Writing Speed—With f2.8 lens, up to 1 in/μsec at only 3000V accelerating potential; higher speeds at higher voltages. With f1.9 lens these values are approximately doubled.

Dimensions—Camera, 10½ x 5¼ x 6¼ in.; hood, 11 in. length, 7½ in. dia; adapter, 2 in. width, 6⅝ in. max. dia.

Weight—Complete, 7¾ lb.

Fairchild-Polaroid Oscilloscope Camera Kits include camera, carrying case and film. Write today for complete data on the Fairchild-Polaroid and Fairchild Oscillo-Record Cameras. *Fairchild Camera and Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y. Dept. 120-15B.*

FAIRCHILD
OSCILLOSCOPE RECORDING CAMERAS

PERSONNEL

Dr. Adolph H. Rosenthal has been named vice-president and director of research and development of Freed Radio Corp., N. Y. He was formerly director of physics.

Theodore Lindenberg has been appointed chief design engineer of Pickering & Co., Oceanside, Long Island, manufacturer of audio components for record playing equipment.

George H. Phelps has been named chief engineer of the Hammarlund Manufacturing Co., manufacturers of commercial receivers, selective calling and remote control apparatus. He was formerly sales application engineer of microwave products for RCA Victor.

Joseph A. Idank has joined the staff of Parco Design Corp., New York City, as chief engineer of the special devices division.

Alan G. Binnie has been appointed vice-president of Kollsman Instrument Corporation, Elmhurst, N. Y., manufacturer of precision aircraft and optical instruments and systems.

Bill C. Scales has been appointed to the position of general sales manager of the cathode ray tube division of Allen B. Du Mont Laboratories. In his new capacity, he will direct the sale of Du Mont CR tubes to manufacturers and parts distributors throughout the world. He was formerly southwestern regional sales manager for the receiver sales division.

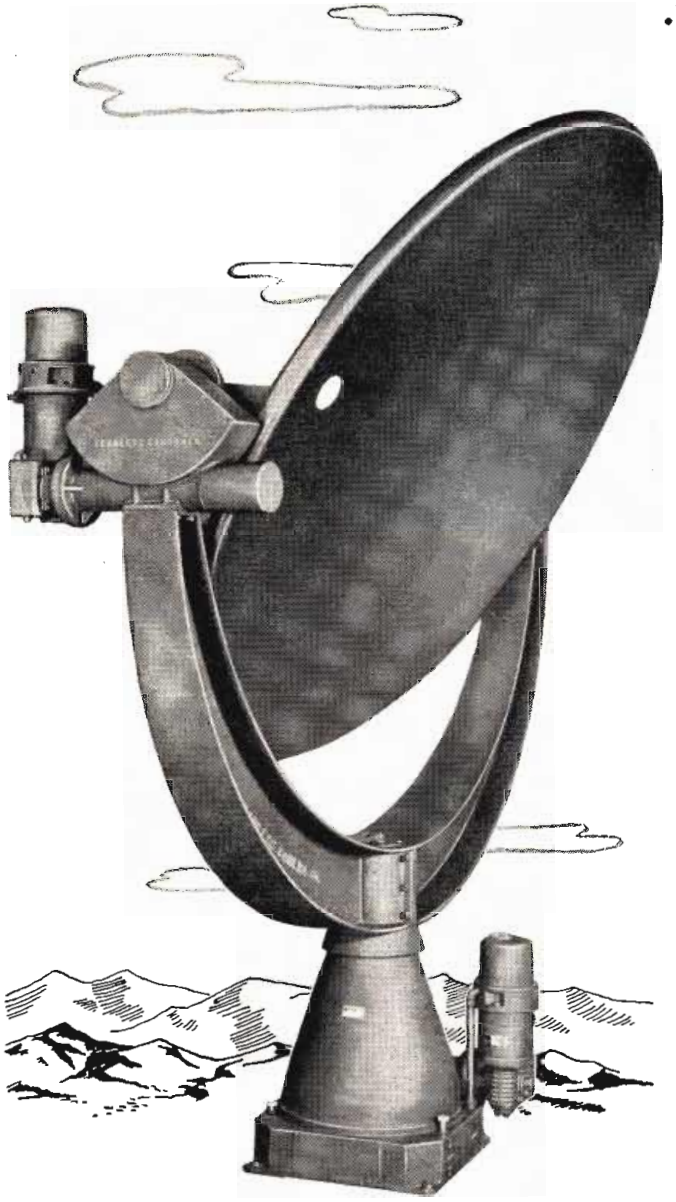
Frank G. Marble, formerly sales manager of Kay Electric Co., Pine Brook, N. J., has assumed the duties of sales manager for Boonton Radio Corp., Boonton, N. J. as of May 1st.

Louis J. Francisco has been appointed vice-president in charge of sales and advertising for the Formica Company, Cincinnati, Ohio. He has been associated with the company for 27 years.

L. P. Blakely, formerly sales engineer with Boonton Radio Corp., Boonton N. J., is sales manager of Tel-Instrument Co., Inc., East Rutherford, N. J., manufacturers of precision electronic equipment.

Henry S. Bamford has been elected president of the Electronic Tube Corp., Philadelphia, Pa.

HIGH ATOP A TOWER | **OR A MOUNTAIN** | **IN WIND, RAIN, SNOW AND ICE**



. . . this new Houston-Fearless

MICROWAVE PARABOLA

operates completely by

REMOTE CONTROL!

There's no need to climb an icy tower in zero weather, wind or rain to position this new Houston-Fearless Remote Control Microwave Parabola. It's all done from the remote control panel (shown below) right in the station.

This Houston-Fearless Parabola can be mounted anywhere within 1500 ft. (or more, if required) of the transmitter. It rotates 370° in azimuth and tilts 15° up and 30° down. Large dials on the remote control panel, calibrated in degrees, show the exact position. It is driven by 1/6 HP motors producing a torque of 10,500 inch pounds @ 1 RPM, sufficient to operate under severe icing conditions. Magnetic brakes prevent overide when Parabola is stopped at any exact position.

Designed to operate in the open without protection, it will withstand a wind velocity of 120 mph. Motors and rotating shafts run on sealed, anti-friction bearings and require no lubrication during the life of the unit. Here is complete dependability and freedom from servicing where it really counts. Write for complete information, or contact your R.C.A. representative.

Write for information on specially-built equipment for your specific needs.

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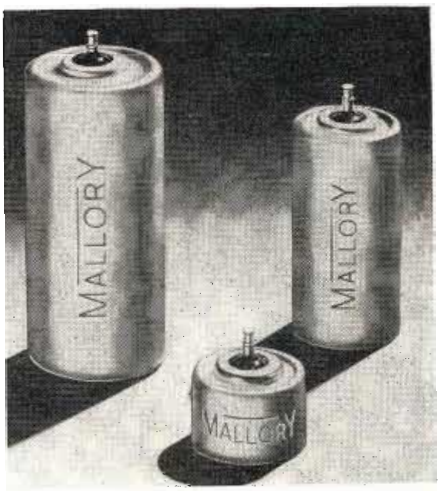
"WORLD'S LARGEST MANUFACTURER OF MOTION PICTURE PROCESSING EQUIPMENT"

Tantalum Electrolytics Being Produced by Mallory

P. R. Mallory & Co., Inc. of Indianapolis, Ind. has recently issued a new bulletin describing their XT type tantalum electrolytic capacitors. These units are designed to operate over a temperature range of —60°C to +200°C and are made in two basic cell sizes.

A porous tantalum compact and tantalum disc form the anode assembly. This assembly together with the elec-



trolyte cathode, is housed in a pure silver lined steel shell. The larger cell has approximately twice the capacity of the smaller cell.

Each capacitor is encased in a strong hermetically sealed housing which is the negative connection of the capacitor. A single terminal is provided for the anode connection. Single cell construction is used in those housed in the ⅞ x ⅝ and 1⅛ x ⅝ case sizes.

Higher voltage ratings are obtained by using two or more cells in series with an accompanying drop in final capacity rating and increase in the length of the case. Multiple cell units are identical in appearance except for the height of the case which increases approximately ⅜" per cell.

The units are available in sizes from 3.5 to 130 mfds with dc working voltages ranging between 12 to 420 volts and leakage currents between 80-125 microamperes.

Imported Components Available

High fidelity audio transformers, power transformers, filter chokes, electrolytic and paper capacitors, and certain RF and AF subassembly components of Danish manufacture are now available through Mogens Bang & Co., P.O. Box 665, Old Saybrook, Conn. In Denmark, with offices in Copenhagen, this company acts as representatives for the General Radio Co., Allen B. DuMont Laboratories Inc., Magnecord Inc., American Phenolic Corp. and others.

Wherever these famous airliners fly, a trusted group of friendly guides goes with them, in the form of Sylvania Radio Tubes.

For, the dependability, long life, and splendid performance of Sylvania Tubes have won them top preference with radio and electronics engineers throughout this country, as well as abroad.

Sylvania's ruggedized tubes are typical examples of the alert engineering which is responsible for the increasing demand for all Sylvania quality products.

What is your problem?

Let Sylvania radio research and advanced engineering work for you. If you have problems—as widely varied as the designing of more compact sets, and the overcoming of shock and vibration—put them up to Sylvania. Address your letters to Radio Tube Division, Dept. R-1406, Emporium, Pa.

SYLVANIA ELECTRIC

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